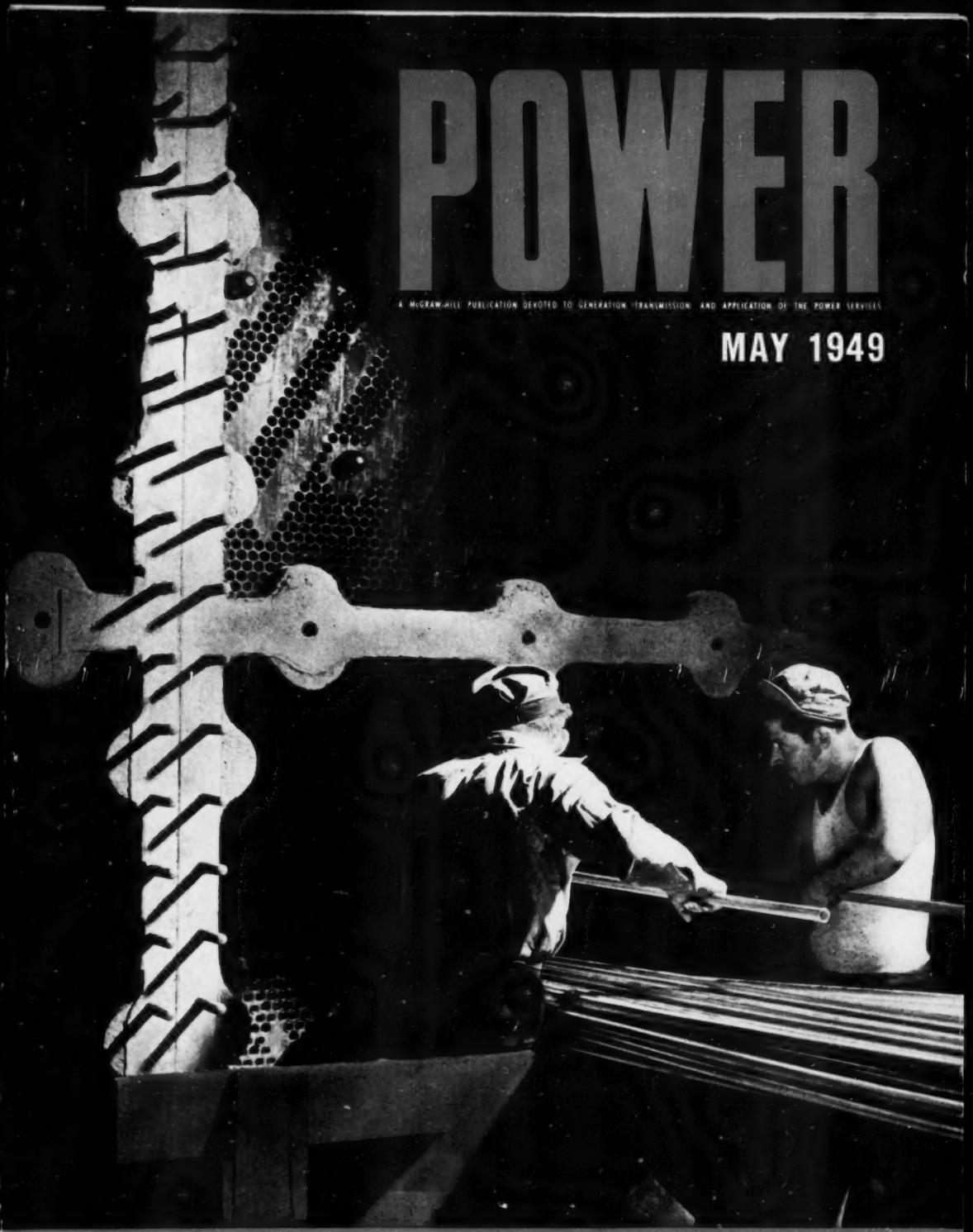
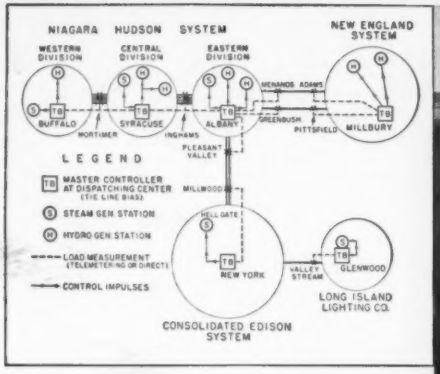
POWER

A McGRAW-HILL PUBLICATION DEVOTED TO GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES

MAY 1949



IN THIS ISSUE: 20,000-kw Hudson Plant features a compact "standardized" design with turbine supporting condenser, centralized control, p 72; new method makes cake ice continuously, p 80; practical tips on: operating compressor plants, p 77; eliminating oil from condensate, p 82; curing headaches in coal handling, p 92. **CONTENTS, p 67**



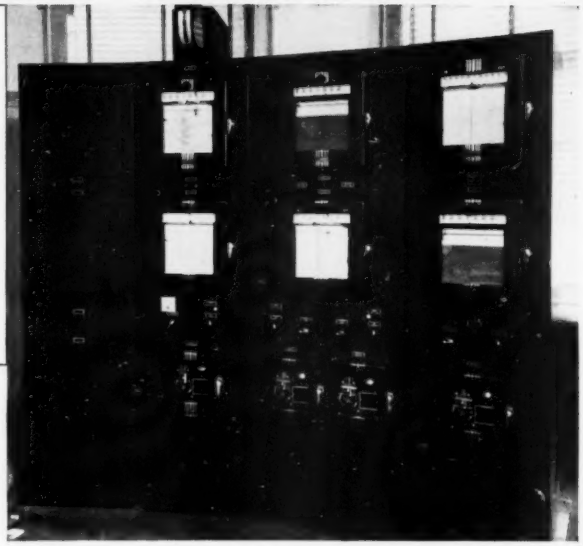


Diagram shows load-frequency control areas of the Northeast Interconnection. At right, the system's L&N master load-frequency equipment for centralized control of tie line and station loading.

Interconnection Carries Heavier Tie Loads With Help Of L&N Load-Frequency Control

The 7-million-kw Northeast Interconnection* which supplies electric power to large areas of New York State and New England, relies on tie-line bias control for load-frequency regulation of all the ties indicated in the above diagram—and the System likes the results.

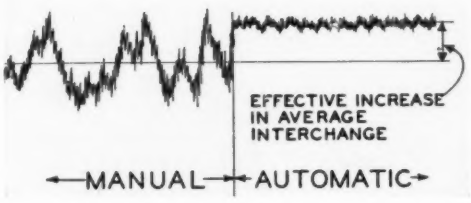
As with other interconnections using the bias method, this network "went through all the early stages" of control—first flat frequency, then selective frequency, then tie line bias. They say "we have continued to expand (tie-line bias control) within the respective Systems, to provide better and better control of the load and therefore better frequency control of the whole interconnection".

"Good Neighbor Policy" of Stations

The Control permits each generating station to be a good electrical neighbor to the others in its interconnection. While many stations operate on the basis of dispatched load, each area is responsible for correcting its own load variations, and scheduled transfers can be worked out between stations for economy or emergency reasons.

Ties Carry Heavier Loads

Regarding the problem of meeting the area's power needs, the Interconnection finds much help in the bias control. "If the interchange were permitted to vary," they say, "a greater operating margin would have to be maintained, between the average tie line load and ultimate carrying capacity. The control reduces fluctuations, therefore closes the gap between actual load and available capacity". This situation is diagrammed in the accompanying illustration.



Visualization of the load-carrying increase of a tie line possible with L&N Load-Frequency Control for tie-line-bias regulation.

L&N equipment is available not only for tie-line load control, but for any other type of regulation. We will be glad to send you a general description of the instruments, but if you have a specific problem, we suggest that you give us the significant details so that we can more clearly present the pertinent facts. Address Leeds & Northrup Co., 4910 Stenton Ave., Philadelphia 44, Pa.

*See "Load-Frequency Control on the Northeast Interconnection" by McCormack & Metcalf in *Electric Light & Power* Feb. 1949. Reprint N-56(2) from L&N on request.

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

LEEDS & NORTHRUP CO.

Jel. Ad ND44-56-461(1)

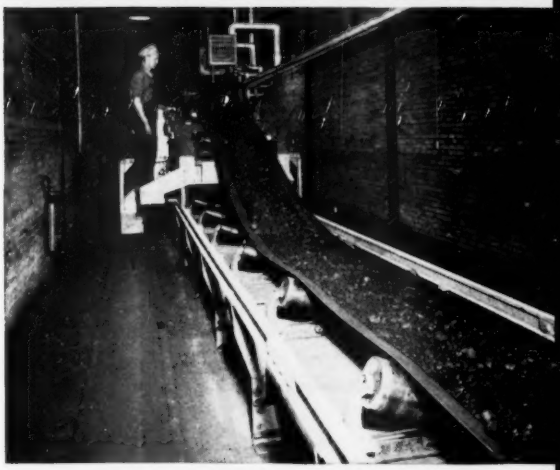
POWER (with which are consolidated "Science and Industry," "The Engineer Review," "The Engineer" and "The Stationary Engineer"), May, 1949, Vol. 93, No. 5. Published monthly with an additional Directory number in June. McGraw-Hill Publishing Company, Inc. Editorial and executive offices, 330 West 42nd Street, New York 18, N. Y. Entered as second class matter January 26, 1949, at the post office at New York, N. Y., under the act of March 3, 1879. Printed in U. S. A. Allow at least ten days for change of address. Subscription rates—U. S. and U. S. Possessions $5 for one year, $7 for two years, 50c per copy. Canada $6 for one year, $9 for two years. Pan American Countries, $10 for one year, $16 for two years. All other countries $15 for one year, $25 for two years. Please indicate position and company connection on all subscription orders.

Barge to Bunker Coal Handling at Cooperative's Alma Steam Plant

Dairyland Power Cooperative's new Alma steam station of 30,000 KW delivers power into the Co-op's transmission system, to which are connected three other Co-op plants. This station is also connected with a private power system.

Link-Belt conveyors play an important part at Alma. Coal arrives in river barges and goes to ground storage or to receiving hopper of conveyor system. Handling units comprise the following: receiving hopper with rack-and-pinion discharge gate . . . inclined overlapping steel apron feeder . . . belt conveyor, 102' long, inclined 18° . . . ring crusher . . . belt conveyor 185' long, inclined 18° for carrying crushed coal or for receiving coal that does not require crushing . . . Weightometer for weighing coal in transit . . . inclined and horizontal belt conveyor, 235' long, equipped with self-propelling, hand reversing belt tripper operating on T-rail tracks mounted across top of coal bunkers. Water for the steam-condensing unit is taken from the Mississippi through two Link-Belt traveling water intake screens located in a screen house.

The design and construction of the entire plant was handled by Vern E. Alden Company, Chicago. For details of coal handling equipment of this or other plants, get in touch with the nearest Link-Belt office.



Top: General view of Alma Steam Power Station as seen from bluffs, looking toward Mississippi River. Above: Link-Belt 24" wide roller bearing belt conveyor with self-propelling hand-reversing "Tank" type tripper for discharging coal to tankers; also shows the plow and belt-seal arrangement against escape of dust.

LINK-BELT COMPANY Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities. 11,432

LINK-BELT

CONVEYING MACHINERY

"THE COMPLETE LINE"

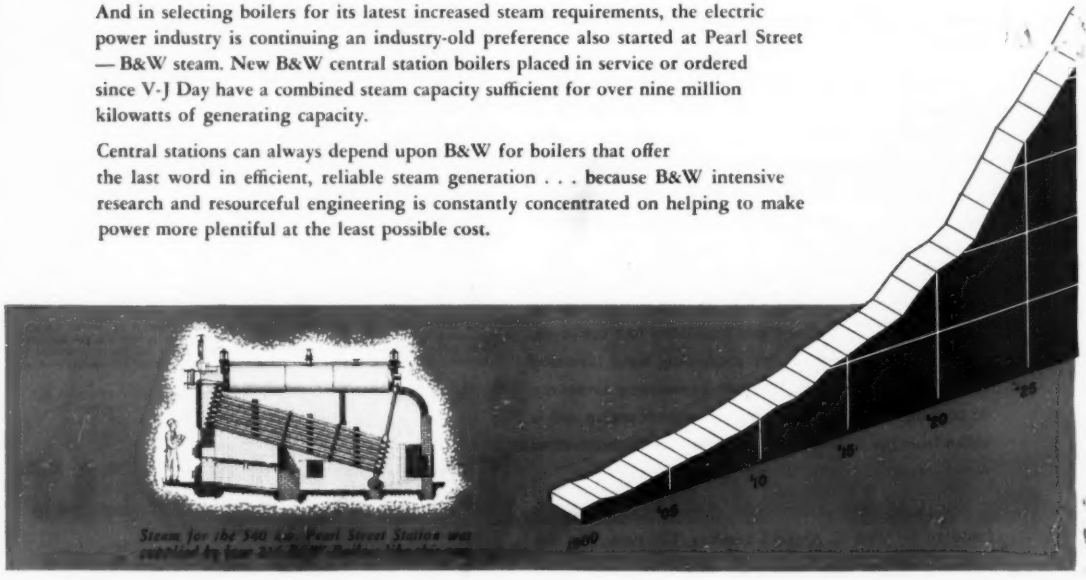
Pearl Street Station in New York City set the pattern for modern central stations.

Pearl Street started an era for making POWER MORE WITH B&W STEAM...

Most of America's new electric power — over 75 percent of it — is being generated by steam-operated equipment . . . a practice started in 1882 at Mr. Edison's Pearl Street Station, grandfather of modern central stations.

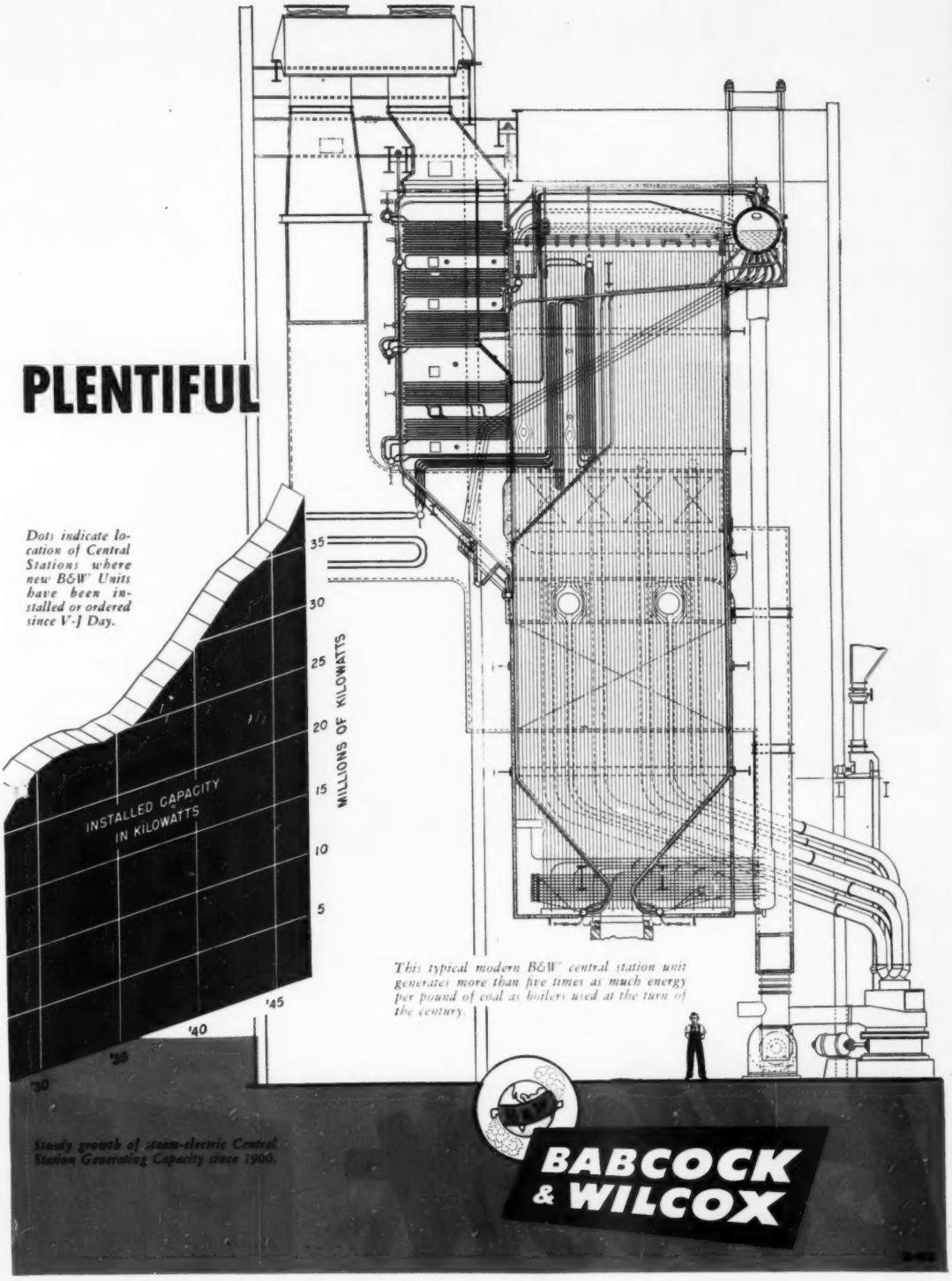
And in selecting boilers for its latest increased steam requirements, the electric power industry is continuing an industry-old preference also started at Pearl Street — B&W steam. New B&W central station boilers placed in service or ordered since V-J Day have a combined steam capacity sufficient for over nine million kilowatts of generating capacity.

Central stations can always depend upon B&W for boilers that offer the last word in efficient, reliable steam generation . . . because B&W intensive research and resourceful engineering is constantly concentrated on helping to make power more plentiful at the least possible cost.



Steam for the 340 Kw. Pearl Street Station was supplied by four 24-H.P. B&W Boilers like the one

PLENTIFUL


Dots indicate location of Central Stations where new B&W Units have been installed or ordered since V-J Day.
INSTALLED CAPACITY IN KILOWATTS
MILLIONS OF KILOWATTS
35
30
25
20
15
10
5
'45
'40
'30
This typical modern B&W central station unit generates more than five times as much energy per pound of coal as boilers used at the turn of the century.
Steady growth of steam-electric Central Station Generating Capacity since 1900.
BABCOCK & WILCOX

Never before in

Elliott

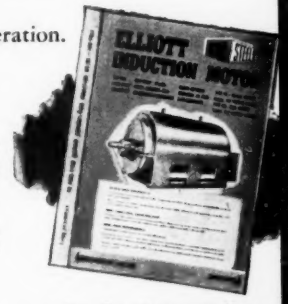
FABRI-

large 2-pole motors

A standardized line of welded all-steel construction; ratings 250 to 3500 hp, 2-pole; drip-proof, splash-proof, enclosed separately (forced) ventilated, enclosed self (pipe or base) ventilated, enclosed self-ventilated with built-in coolers, sleeve bearings (ring-oiled or pressure lubricated) with all these features:

1. Removable, long life, split-sleeve bearings and housings for easy inspection or replacement.
2. Extra sealing of bearing housings against oil leakage.
3. Rigid, one-piece, steel bearing brackets* — yet easy to handle for maintenance.
4. Rigid, heavy, all steel frame to suppress double frequency noises.
5. Dynamically balanced rotor for smooth, long life, operation.
6. Directed ventilation for extra cooling.
7. Rotor and air passageways designed for quiet operation.

*Available with pedestal bearings on request.



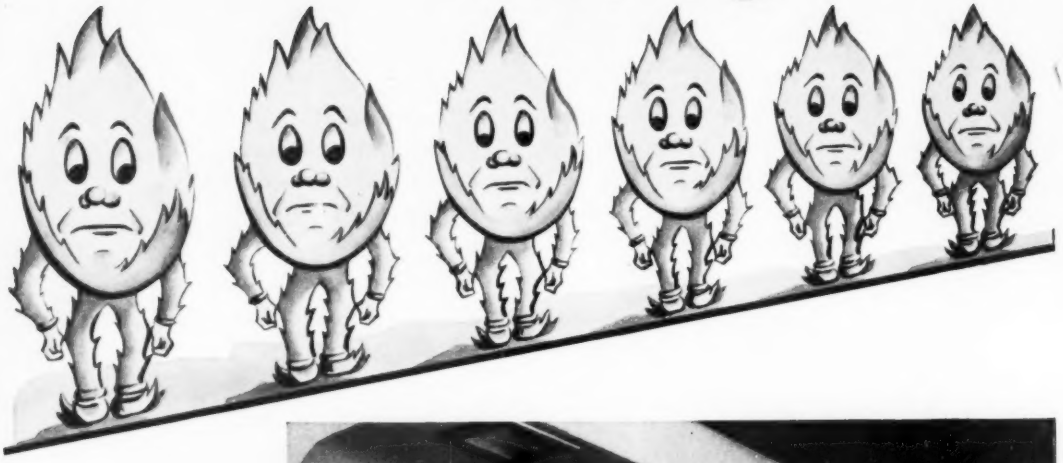
L-790

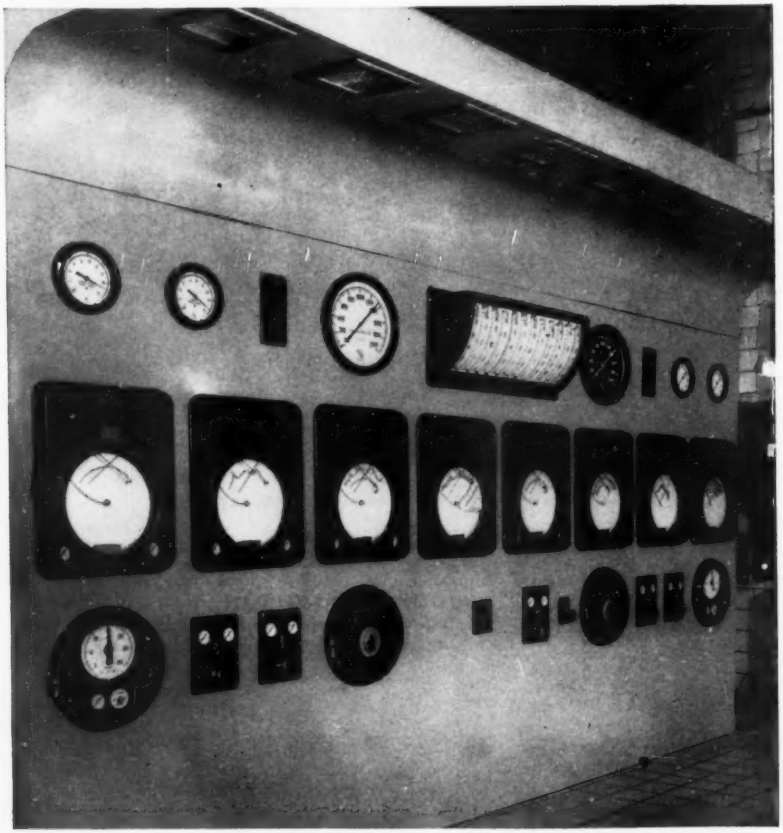
ELLIOTT COMPANY
RIDGWAY DIVISION, RIDGWAY, PA.
Plants at: JEANNETTE, PA. • RIDGWAY, PA. • SPRINGFIELD, O. • NEWARK, N. J.
DISTRICT OFFICES IN PRINCIPAL CITIES

For descriptive Bulletin PB 7000—1, write to Department P, Elliott Company, Ridgway Div., Ridgway, Pa.

-STEEL Motors

Keeping Btu's



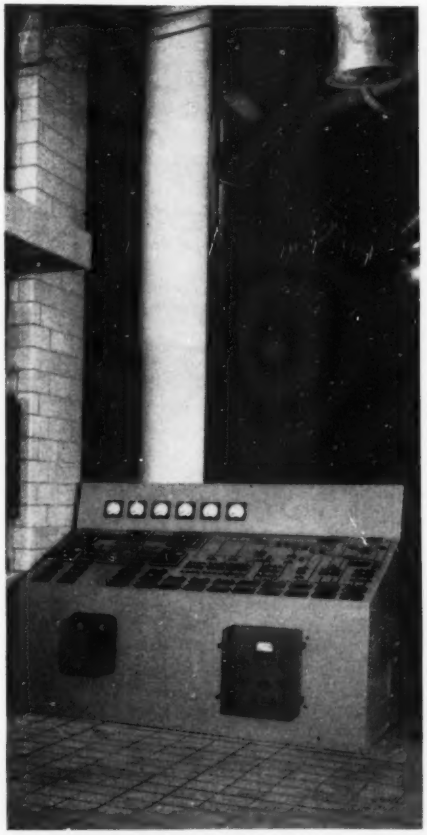


Bailey Boiler Control Panels for 200,000 lb per hour capacity, 880 psi, 900° F pulverized coal-fired boiler at the Hudson Steam Plant of Rockland Light and Power Company, Tomkins Cove, New York. All

Branches in: Atlanta Boston, Buffalo, Charlotte, Chicago, Cincinnati, Denver, Detroit, Houston, Kansas City, Los Angeles,

IN LINE

at Tomkins Cove



Boiler Controls are co-ordinated to insure efficient handling of the heat energy released in combustion.

● Optimum conditions in routine operation are provided for at the Hudson Steam Plant of Rockland Light and Power Company. This new station at Tomkins Cove, New York, keeps Btu's in line with a complete installation of Bailey Boiler Controls, all co-ordinated to work as a team in directing the efficient use of heat energy.

The installation includes:

Bailey Combustion Control

Bailey Three-element Feed Water Control

Bailey Steam Temperature Control

Bailey Coal-Air Temperature Control

Bailey Three-element Condensate Control.

It's easy to keep Btu's in line with co-ordinated controls engineered to fit your plant.

Call your local Bailey Engineer for recommendations on how meters and controls can help you to get more useable heat energy from your fuels.

A-108-2

BAILEY METER COMPANY

1036 IVANHOE ROAD · CLEVELAND 10, OHIO

BAILEY METER COMPANY LIMITED, MONTREAL, CANADA

BAILEY METERS

Controls for Steam Plants

COMBUSTION · FEED WATER · TEMPERATURE

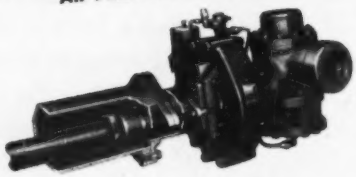
PRESSURE · LIQUID LEVEL · FEED PUMPS

Milwaukee, New Orleans, New York, Philadelphia, Pittsburgh, St. Louis, St. Paul, San Francisco, Schenectady, Seattle

THE UPWARD TREND

DIAMOND LEADERSHIP CONTINUES IN THE TREND TO AUTOMATIC OPERATION

DIAMOND Model A2E Automatic Air Puff Soot Blower



Automatically cleans heating surfaces by series of compressed air puffs delivered through permanently installed multiple nozzle blowing element.

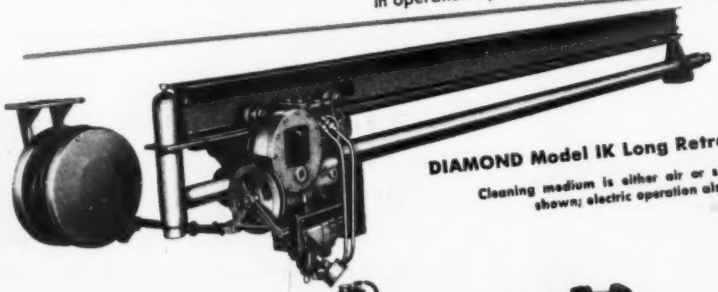
DIAMOND Model G9B Soot Blower

Uses steam as cleaning medium through permanently installed multiple nozzle blowing element. Operation is manual, air (shown) or electric.

DIAMOND Model IS Short Retracting Soot Blower

Uses either air or steam as cleaning medium. Operation is manual, air (shown) or electric.

Manually operated Diamond Soot Blowers can be converted to automatic operation; they can also be made sequential in operation by the addition of a control panel.



DIAMOND Model IK Long Retracting Soot Blower

Cleaning medium is either air or steam. Air operation shown; electric operation also available.

DIAMOND Telescopic Long Retracting Soot Blower

Uses air or steam as cleaning medium. Operation is either air or electric (shown).

CONTINUES . . .

MORE AUTOMATIC SOOT BLOWERS in Central Stations

52% of the DIAMOND SOOT BLOWERS sold to Central Stations during 1948 were for AUTOMATIC OPERATION

Central Stations, where the need for equipment of maximum economy and effectiveness is most keenly felt, show an increasing preference for soot blowers with automatic sequential operation. Our records indicate that 52% of the Diamond Soot Blowers sold to Central Stations in 1948 were automatic in operation . . . a significant increase over any previous year.

This marked trend to automatic sequential operation is a logical outcome of the many advantages offered by Diamond Automatic Soot Blowers over those having manual operation. Among these advantages are: (1) thorough cleaning is always assured . . . no blowers can be forgotten or operated in a careless or incorrect manner, (2) labor is saved . . . blowers do not have to be tended individually, (3) some saving of energy from the coal pile, and (4) remote operation from the boiler control panel or other convenient point.

Diamond pioneered automatic soot blowing . . . with both air and steam as the cleaning medium. Diamond installed the first automatically operated soot blowers in 1921. The continuous research, development and application engineering that Diamond has carried on since that time have resulted in a leadership and "know how" that is unapproached in this field. For the correct answer to your soot blowing problems, consult Diamond.

3851

DIAMOND POWER SPECIALTY CORP.
DETROIT 1, MICHIGAN
Diamond Specialty Limited • Windsor, Ontario

WRITE FOR BULLETIN 1014
It illustrates and describes the varied line of Diamond Soot Blowers . . . shows how they meet differing needs.

The Trend is to...

REPUBLIC REGULATOR APPLICATIONS

Pressure Control
Steam pressure control
Boiler furnace draft
Primary air pressure
Feed water pressure
Evaporator pressure
Process steam pressure
Blast air pressure
Exhauster suction
Fuel gas pressure
Suction main pressure
Excess pressure

Flow Control
Water flow to desuperheaters
Water flow to condensers
Oil flow to boilers and furnaces
Gas flow to boilers and furnaces
Air flow to gas producers
Pump bypass

Level Control
Hot well levels
Surge tank levels
Storage tank levels
Evaporator levels
Boiler water levels

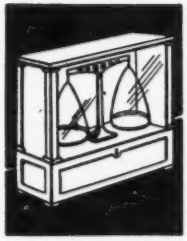
Speed Control
Stoker and fuel feeder speeds
Pulverizer speed
Pump speed
Fan speed
Steam turbine speed
Steam engine speed
Variable speed motors
Variable speed transmissions

View of a Republic hydraulic type regulator for controlling boiler air flow, mounted on stand with power cylinder.

REPUBLIC
INSTRUMENTS
AND CONTROLS

REPUBLIC Regulators

Because They Meet These Four Essentials of Good Regulation



Republic Regulators can be made sensitive to changes of less than 0.002 of an inch of water.

SENSITIVITY

The amount of change that is required in the quantity being controlled to effect the regulator is the measure of its sensitivity. For close, accurate regulation, a regulator must be sensitive. It must respond immediately to the slightest deviation from the predetermined setting or the controlled quantity may vary far beyond the permissible limits.

Republic Regulators will meet any speed requirement up to one full stroke in 2 seconds.

SPEED

The speed at which a regulator operates is an important factor in any control system. Any time lag between the variations in the controlled quantity and the operation of the control device to correct this variation, will produce an unnecessary error in regulation. A regulator, therefore, must be fast enough to follow the fastest load fluctuation.

Republic power cylinders are available to meet the specific power requirements of any particular installation.

POWER

A regulator must have sufficient power to not only operate the valve or other control device, but also to overcome any accidental friction or sticking that may occur in any part of the system. Insufficient power will cause failure in operation. It is for this reason that regulators are made with different size power cylinders, the smaller sizes being used for small valves and the larger sizes for the larger dampers and louvers.

The Republic stabilizer will stabilize against any time lag in the operation of the equipment being controlled.

STABILITY

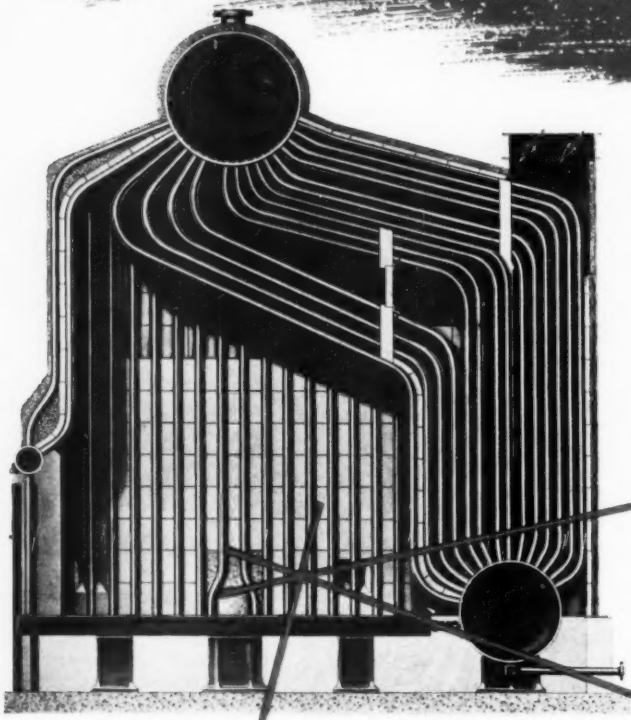
Stability refers to the ability of a regulator to maintain its balanced position or to return immediately to a balanced position if the controlled quantity is disturbed. There is always an interval between the time the valve or other control device is moved and the time the controlled quantity changes in response to this movement. Unless a regulator is stabilized it will tend to "hunt" or overtravel causing unnecessary variations.

Write for Data Book No. S-13

Republic Flow Meters Co.

2222 Diversey Parkway • Chicago 47, Illinois

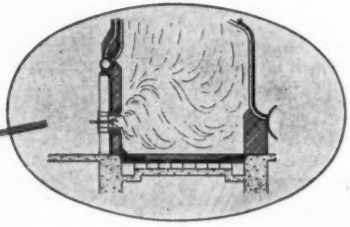
THE C-E PACKAGE BOILER



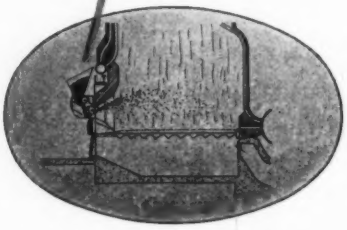
Furnished in capacities of

10,000 to 50,000

lb of steam per hr, the Package Boiler is designed for four methods of firing — spreader stoker, single-retort underfeed stoker, oil or gas burners. Any of these methods may be substituted for any other should a change in the fuel market make a change in firing equipment desirable.



OIL OR GAS BURNERS — The Package Boiler is ideally suited to the use of either oil or gas. Designed for front wall firing, the furnace is properly proportioned for the normal flame characteristics of the burners and provides ample volume for completion of combustion before the gases enter the boiler.



C-E SPREADER STOKER — Installations of C-E Spreader Stokers throughout the United States and in many foreign countries have demonstrated the ability of this stoker to burn every kind and grade of bituminous coal, as well as sub-bituminous coals and lignite. It has been notably successful in burning the lower-priced poorer grades of coal which are so difficult to burn satisfactorily on other types of stokers.

COMBUSTION ENGINEERING

A MERGER OF COMBUSTION ENGINEERING COMPANY, INC. AND THE SUPERHEATER COMPANY

. . . . Choice of industry after industry

Why has the Package Boiler been selected by such widely varying industries as those listed?

BALANCED DESIGN

BECAUSE it has not one or two features for special needs, but a *completely balanced design* that adapts itself to many conditions . . . a design in which each element is coordinated with every other for top performance.

EFFICIENT PERFORMANCE

BECAUSE the C-E Package Boiler has high efficiency over a wide range of output and responds to rapid load swings . . . characteristics especially advantageous in many industrial plants.

EASY OPERATION

BECAUSE the C-E Package Boiler is simple to operate and maintain at peak efficiency — a boon to plants having limited personnel.

CHOICE OF FUELS AND FIRING

BECAUSE in addition to its wide adaptability, the C-E Package Boiler permits you to choose the one *best* method of firing for the fuel and load conditions of *your* plant.

LOWER COST

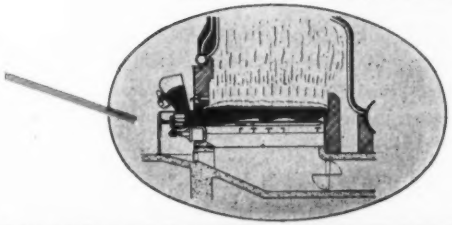
BECAUSE the standardized balanced design of the C-E Package Boiler effects economies in engineering, fabrication, and erection which are passed on to you in lower first cost.

UNIFIED RESPONSIBILITY

BECAUSE the C-E Package Boiler is a complete unit . . . boiler, furnace setting, fuel-burning equipment, controls, forced draft . . . giving you the added benefit of *one contract, one guarantee* and *one responsibility*.

• • •

Small wonder so many diverse industries select the C-E Package Boiler. If your requirements fall within the available capacity range, let C-E engineers match your needs to Package Boiler performance.



TYPE E UNDERFEED STOKER — Designed to burn both caking and non-caking bituminous coals, the Type E Stoker is one of the oldest and best-known stokers in America. Sound design, rugged construction and fine performance have made the Type E Stoker the recognized leader in its field.

PARTIAL LIST OF INDUSTRIES THAT HAVE SELECTED THE C-E PACKAGE BOILER

AUTOMOBILE
BAKERY
CHEMICAL
COLD STORAGE
DAIRY
GLASS
HOSIERY
HOSPITAL
INSTITUTIONS
LEATHER
LINOLEUM
MACHINERY
METALS
OIL
PACKING
PAINTS
PAPER
RAILROADS
RUBBER
STEEL
SUGAR
TEXTILE
TOBACCO
UTILITY

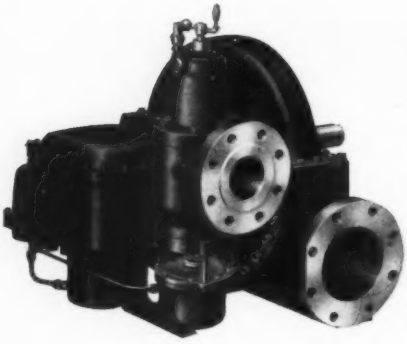
—SUPERHEATER, INC.

200 MADISON AVENUE, NEW YORK 16, N. Y.

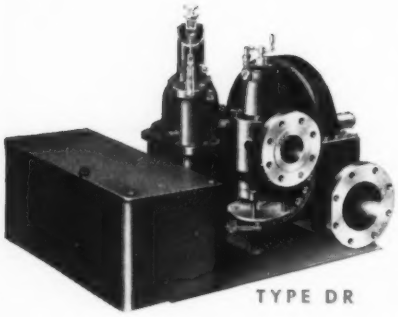
C-E

GENERAL ELECTRIC ANNOUNCES

A NEW STANDARDIZED



TYPE DP



TYPE DR

STANDARDIZATION EXTENDED

Last year General Electric announced what we believe to be the greatest value in small turbine history—the Type DP. This standard turbine, which offers a host of special features at no extra cost, is suitable for the great majority of applications within its speed and horsepower range.

For drives of higher speeds, or requiring wider speed range, or greater accuracy of control, the new oil-relay governed Type DR turbine is now available. This standardized design powers many drives which formerly could be handled only by a more expensive, custom-built unit.

To simplify maintenance, the Type DR is coordinated with the basic Type DP design to provide as much standardization of parts and dimensions as possible. For instance, bearings, packings, shafts, oil coolers, and many other parts are interchangeable on all frame sizes of both DP and DR units. Installation and re-location are simplified by a common shaft height and coupling fit.

By the selection of a Type DR drive, you get the advantages of a custom-built, oil-relay governed turbine, along with the ease of maintenance and handling offered by a standardized unit.

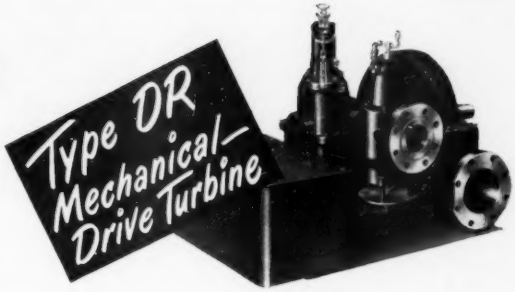
For assistance in applying the right turbine to the right job, get in touch with your G-E representative. He'll be glad to show you how the special features of G-E mechanical-drive turbines offer you extra value. Apparatus Department, General Electric Company, Schenectady 5, N. Y.

TURBINE!

FOR

HIGH SPEEDS,

WIDE SPEED RANGES, GREATER ACCURACY OF CONTROL



The new Type DR turbine is almost universally applicable within its range of ratings. Speed range under governor control is more than sufficient to handle all types of variable speed pumps, fans, compressors, blowers, stokers, and many types of paper machines. The accuracy afforded by the standardized, oil-relay governor even permits smooth parallel operation of a-c generators.

Ratings up to 1500 hp are available, with speeds from 1000 to 8000 rpm.

SAFE IN EXPLOSIVE ATMOSPHERES—non-sparking emergency governor standard on all units

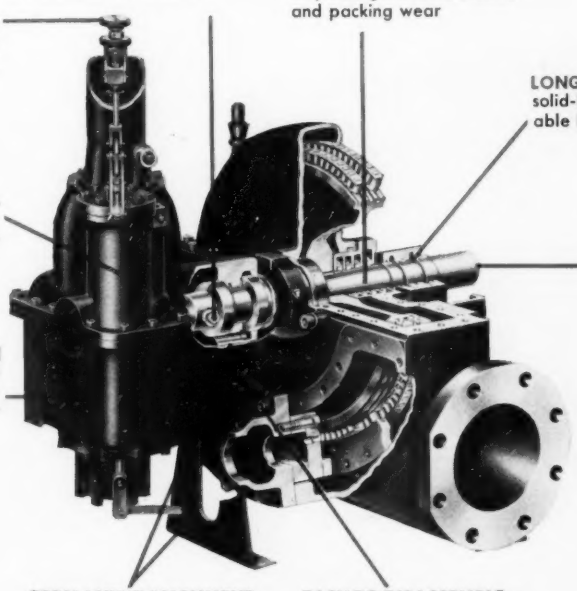
LESS MAINTENANCE—Monel spraying of journals at packings reduces erosion and packing wear

WIDE SPEED RANGE—powerful oil-relay governor provides adjustable speed range up to 5 to 1

LONG-LIFE BEARINGS—solid-backed interchangeable bearings

GREAT ACCURACY—steady state governor accuracy of ±¼ of 1 per cent

EASY TO INSTALL—standard shaft height and coupling fit permit installing and re-locating units with a minimum of effort



POSITIVE LUBRICATION—pump provides pressure lubrication for turbine bearings and, if desired, for driven equipment

PERMANENT ALIGNMENT—center-line support eliminates casing strains, keeps unit in alignment, reduces coupling wear

EASY TO DISASSEMBLE—casings and other parts secured by easy-to-handle socket-head cap screws, which replace conventional bolting

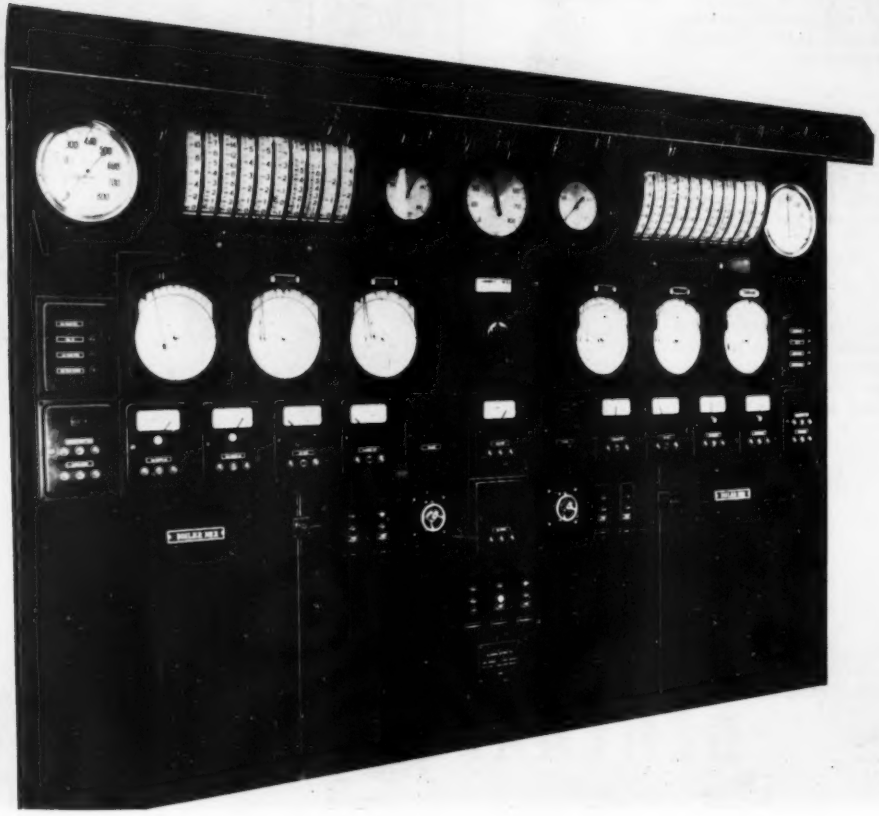
GENERAL ELECTRIC

STEAM CAPACITY GOES **up**

STEAM COST GOES **down**

IT'S MODERN!

It's Electrical



When HAYS *Automatic*
Combustion Control *GOES IN*

It's practically a certainty that **you will get more steam capacity to meet increased production needs** when you install Hays Automatic Combustion Control. That is why Hays Systems, almost without exception, quickly pay for themselves.

Here's a typical case:

When steadily increasing production taxed the capacity of its three boilers, a food company* installed Hays Combustion Control. Immediately production jumped almost 100 percent **using only two boilers,** with the third for stand-by. Turbine steam consumption dropped 1000 pounds per hour, boiler efficiency rose from 55 to 78½ percent, and steam costs dropped sharply.

Is your steam plant keeping pace with growing demands? Consider how much more practical and inexpensive it is to **increase capacity of your present plant by the Hays Method** than to invest in additional boilers.

It's "good business" to talk over your steam plant requirements with a Hays engineer. Meanwhile, send for Bulletin 49-605—important reading.

*Name upon request.

ALL THESE POTENT ADVANTAGES ARE BASIC IN HAYS Automatic COMBUSTION CONTROL

Steam pressure is maintained practically constant under wide variations in steam demand.

Correct fuel-air ratio is maintained for most efficient combustion.

Over-fire draft is maintained constant at a predetermined value.

Fuel-burning rate is kept in step with steam demand.

Furnace and boiler are protected by the more uniform firing conditions and by the smaller fluctuations of steam pressure and furnace temperature.

More uniform pressure improves turbine room efficiency and protects the quality of processed products.

Fuel and maintenance costs are definitely lowered.

Electrical operation makes for simplicity in installation, operation and maintenance.

Uniform high efficiency and CO_2 in the flue gas are maintained over a wide range of rating.

Corrections are made before conditions get out of hand. Always on the job, never tires, never forgets.

Clinker trouble is lessened. (Periods of unnecessarily high combustion rates so common with hand control, are eliminated.)

Load variations can be carried by the entire battery of boilers or by an individual boiler, as desired.

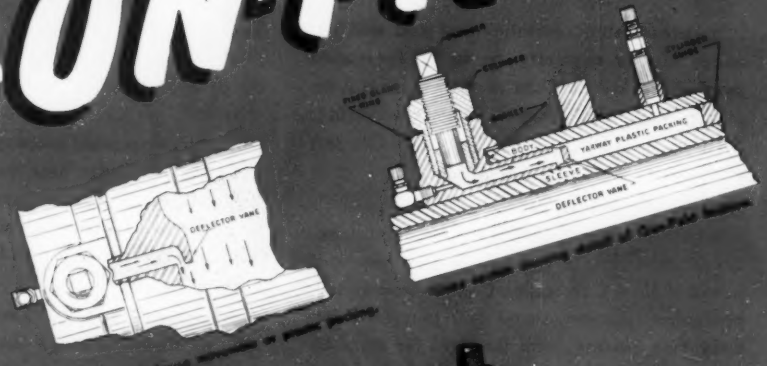
Operator is relieved of many details, leaving him free to attend to more important duties in the boiler room.

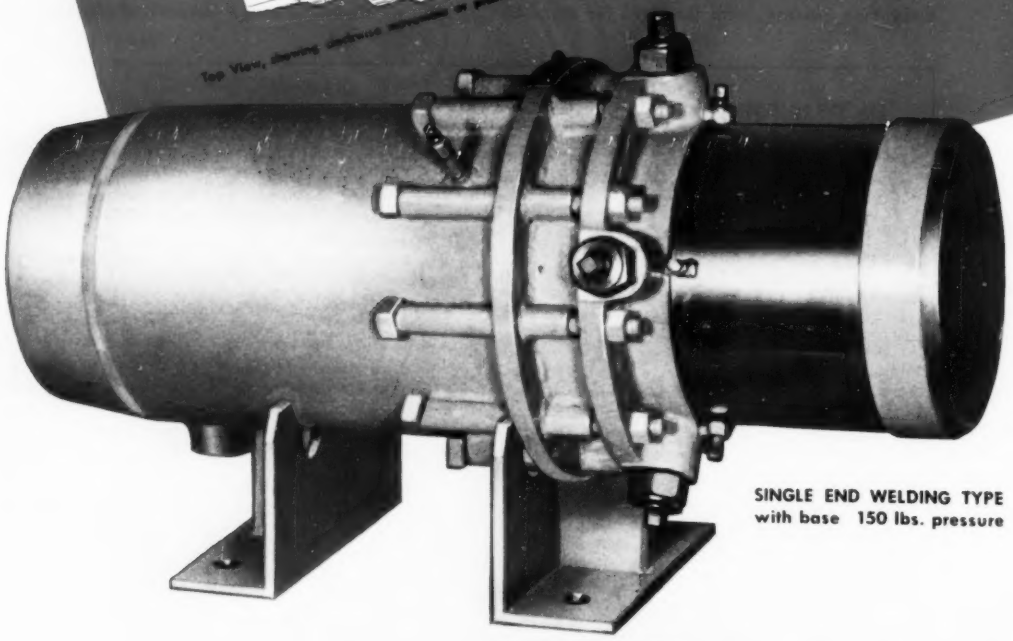
Automatic
COMBUSTION CONTROL

INDUSTRIAL CONTROL • FLOWMETERS • GAS ANALYZERS • DRAFT GAGES • CO_2 RECORDERS

THE HAYS CORPORATION, MICHIGAN CITY, INDIANA

SAVE LABOR WITH GUN-PAKT





SINGLE END WELDING TYPE
with base 150 lbs. pressure

YARWAY

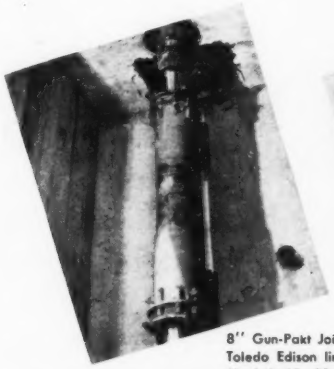
TOLEDO EDISON CHOOSES THE EXPANSION JOINT THAT IS *Serviced* UNDER FULL STEAM PRESSURE

Toledo Edison Company knows how to save on expansion joint maintenance. They use Yarway GUN-PAKT Joints—22 of them, ranging in size from 8″ to 14″ on their recent steam distribution extension.

GUN-PAKT Joints are serviced under full steam pressure . . . no costly shutdowns or heating interruptions. For repacking, simply insert a packing plug, twist a wrench, and the job's done! Special Alemite fittings provide for proper lubrication. Maintenance costs are low. One user says only 65 cents per year per joint. Others claim less than that. But wherever steam is distributed, and expansion joints are used, the trend is toward GUN-PAKT.

Read the GUN-PAKT story in Yarway's Bulletin EJ-1912. Write—

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.

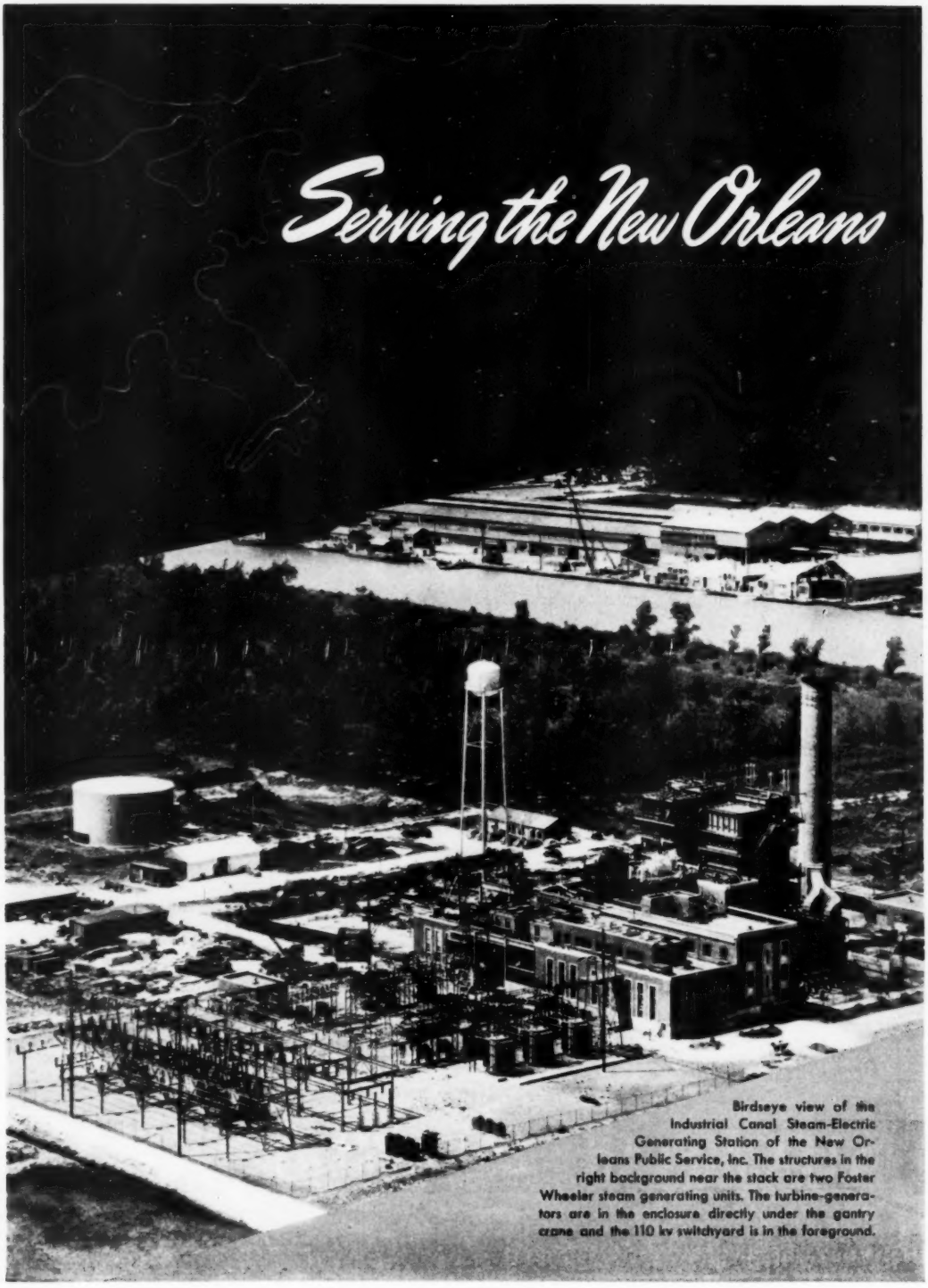


8″ Gun-Pakt Joint on Toledo Edison line at Manhole No. 12.

Yarway Gun-Pakt Joint on Toledo Edison Jackson Avenue line.

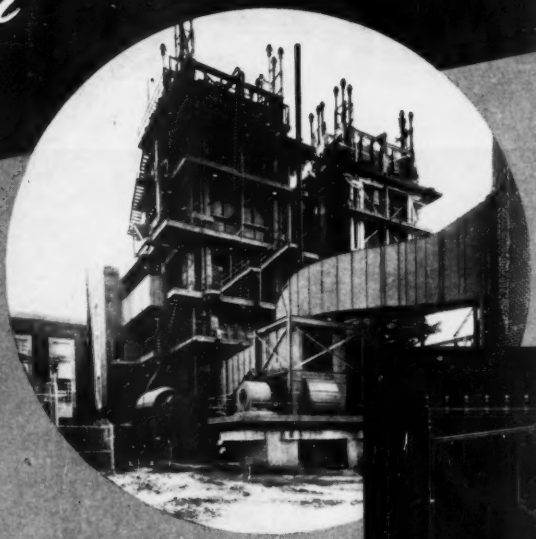
14″ Gun-Pakt Joint in Toledo Edison No. 1 Manhole.

Serving the New Orleans



Birdseye view of the Industrial Canal Steam-Electric Generating Station of the New Orleans Public Service, Inc. The structures in the right background near the stack are two Foster Wheeler steam generating units. The turbine-generators are in the enclosure directly under the gantry crane and the 110 kv switchyard is in the foreground.

area

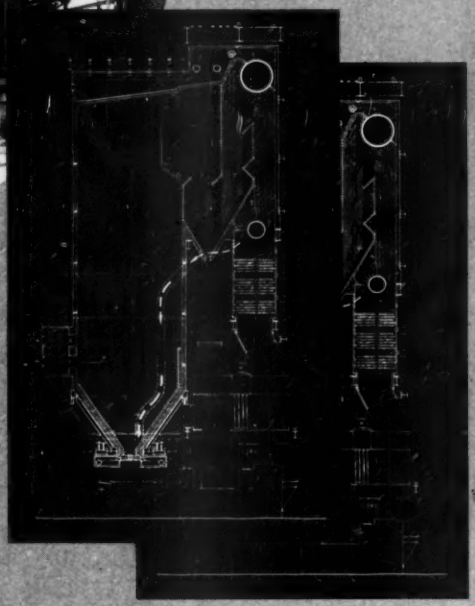


Two Outdoor Foster Wheeler Steam Generating Units for

Industrial Canal Steam-Electric Generating Station of

New Orleans Public Service, Inc.

Steam capacity per unit	400,000 lb per hr
Superheat control range	225,000 lb per hr to 400,000 lb per hr
Pressure superheater outlet	1,350 psi
Final steam temperature	955 F



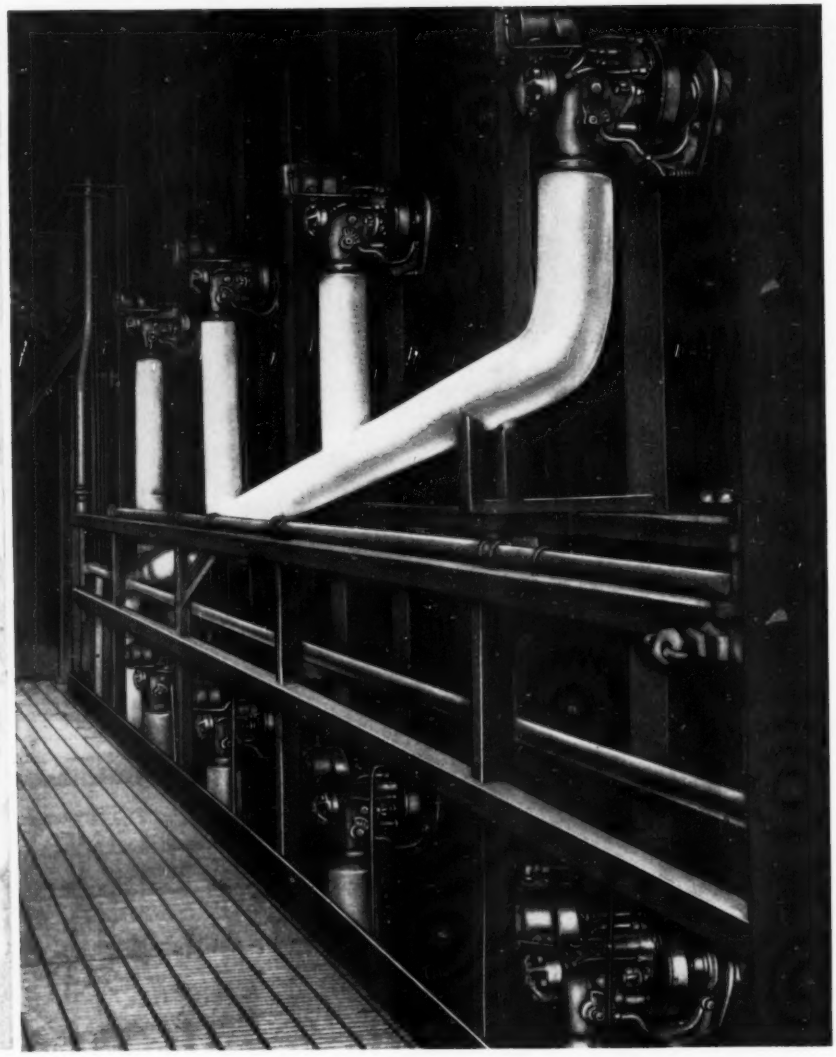
The Industrial Canal Steam-Electric Generating Station of the New Orleans Public Service, Inc. is in consonance with the times which more than ever demand a sensible investment policy. This modern station combines lower investment cost of semi-outdoor construction with operating economies of a high pressure and high temperature steam cycle. Two 400,000 lb per hr FW steam generators, which are completely outdoors, serve two 37,500 kw turbines which are housed in individual semi-demountable enclosures directly under a single gantry crane.

The steam generating units are designed for firing natural gas, oil, or future pulverized coal and are arranged for automatic condenser-type steam temperature control.

FOSTER WHEELER CORPORATION, 165 Broadway, New York 6, N. Y.

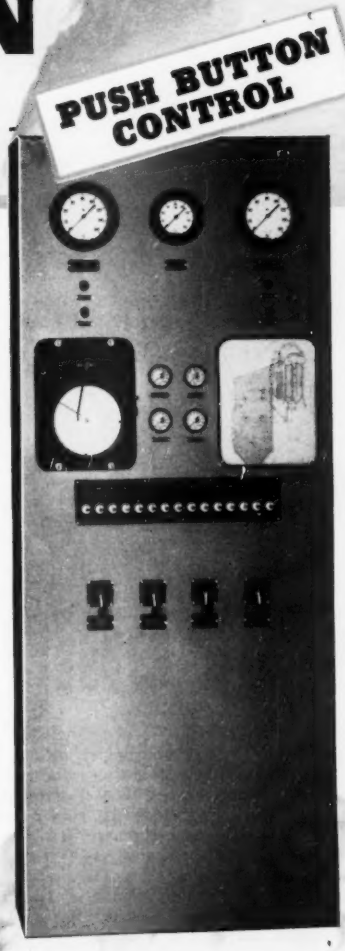
FOSTER WHEELER

for AUTOMATIC ---by Steam



Sequential Soot Blowing it's VULCAN

Because of Unusual Design and Flexibility



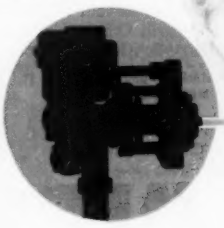
Push one button on the master control panel, and you operate the entire system and shut it down. Blow by groups, if you like. Skip one unit, or a number of units, as you wish. Any combination is possible by a simple turn of control buttons—as easy as that.

But you want to blow with compressed air? Fine! Vulcan air systems are in successful operation on many modern boilers.

More and more engineers now specify Vulcan Automatic Sequential Blowers. Ask us to show you why.

VULCAN SOOT BLOWER CORPORATION
DUBOIS, PENNSYLVANIA
DIVISION OF
CONTINENTAL FOUNDRY & MACHINE CO.

VULCAN
STEAM OR AIR



SOOT BLOWERS

Cuts Pump Upkeep

COST DOWN MORE THAN HALF IN 4 YEARS SERVICE AT MICH. CITY PLANT

SAYS A. C. LOHSE, General Power Engineer, Pullman-Standard Car Manufacturing Company — "Maintenance costs on our old pump were sky-high, so in March, 1945, we installed this *Electrifugal* pump to move condensate from our compressors and hydraulic pumps. It has run 16 hours a day, five days a week with only routine maintenance and one repacking. Cost per gallon is less than half what it was and performance is much more dependable."

This is the kind of dependable, cost-lowering service you can get from *Electrifugal* pumps. Motor and pump are mounted on *one* shaft in *one solid frame* for maximum rigidity. Feet are wide spread for firm support. Bronze ring protects casing from wear by impeller and is easily replaced when required.

Every *Electrifugal* pump is tested at the factory. Performance is guaranteed.

Allis-Chalmers makes hundreds of pumps for many types of service. For full information, see your A-C Authorized Dealer or District Office, or write for Bulletin 52B6059E. Also in Sweet's. A 2640

ALLIS-CHALMERS, 952A SO. 70 ST. MILWAUKEE, WIS.

Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and District Offices throughout the country.

MOTORS — ½ to 25,000 HP and up. Matching Allis-Chalmers Control.

TEXROPE — Belts in all sizes and sections, standard and Vari-Pitch sheaves, speed changers.

PUMPS — Integral motor and coupled types. Sizes and ratings to 2500 GPM.

Electrifugal, *Texrope* and *Vari-Pitch* are Allis-Chalmers trademarks.

A-C ALLIS-CHALMERS

ALLIS-CHALMERS

Power Company "Finds" New Storage Space—

Big As All Outdoors

Storing coal reserves and easy coal movement to boiler room bunkers were a major problem at this great power plant. In seeking the answer, S-A had to *find* new storage space. Now, with an S-A Redler and Belt Conveyor System, a huge coal reserve is stockpiled . . . 54,000 tons of it . . . outdoors.

Day-after-day, year-after-year, Stephens-Adamson engineers have been developing bulk materials handling methods and equipment for better results in specific applications. This back-log of experience has given them the "know-how" that cracks bulk materials handling problems quickly . . . economically.

To improve your present bulk materials handling system or for recommendations about a new unit, our staff is at your service. Write us today.

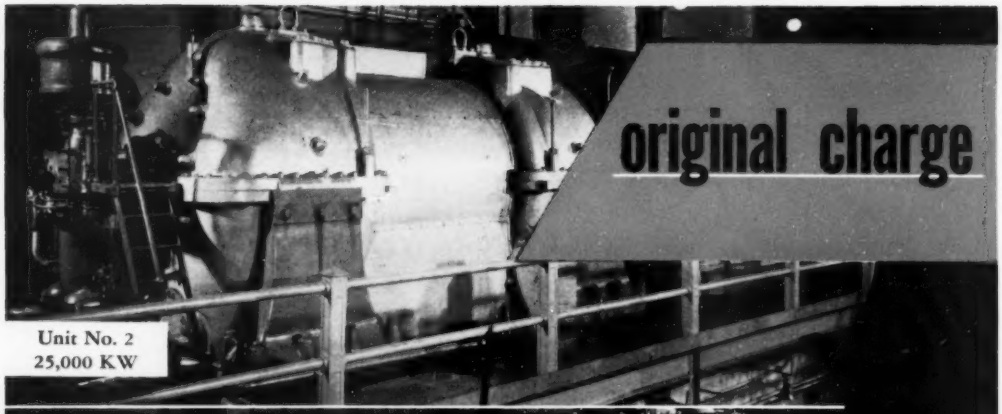
Interstate Power Company
Dubuque, Iowa

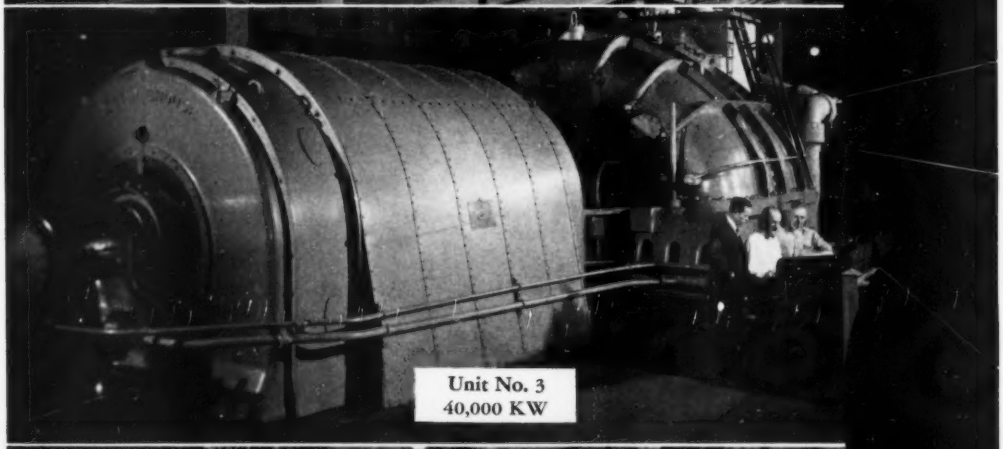
Coal from river barges and rail cars is unloaded and spread over on a large outdoor storage area. Tractor drawn carry-alls reclaim coal as needed and deliver to a receiving hopper at the base of the REDLER elevator shown above. The REDLER elevates to a 90-foot long belt conveyor, which moves coal into the plant for distribution to storage bunkers. Coal from cars can also be diverted to the pile shown at left. Capacity of S-A handling system is about 75 T.P.H.

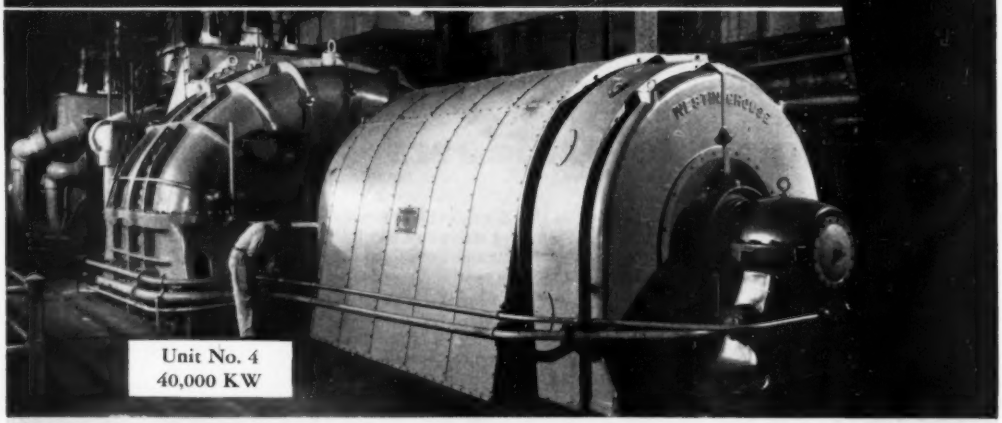
STEPHEN S-A DAMSON MFG. CO.

5 Ridgeway Avenue, Aurora, Illinois · Los Angeles, Calif. · Belleville, Ontario

DESIGNERS AND MANUFACTURERS OF ALL TYPES OF BULK MATERIALS HANDLING EQUIPMENT







Actual

GULFCREST

performance record
Unit No. 4

# of GULFCREST OIL

has *12-year record* of outstanding performance in 40,000 and 25,000 KW Turbines

Over 12 years of service and still providing outstanding lubrication — that's the performance record of Gulfcrest Oil in these three big turbines! Additional evidence that Gulfcrest Oil lasts indefinitely!

Typical of the neutralization number curves for these units is the one shown below for Unit No. 4. Note the consistently low neutralization number of Gulfcrest Oil during and after this remarkably long service.

As a result of outstanding operating experience with Gulfcrest Oil, it has been selected by this important utility for each successive new turbine installation since 1937 — today every unit in the system is lubricated with Gulfcrest!

Here's the important reason for operating records like this with Gulfcrest Oil: extra refining by the Alchlor Process which not only removes more of the sludge formers than any other refining method, but imparts to the oil greater ability to benefit from the addition of special inhibitors.

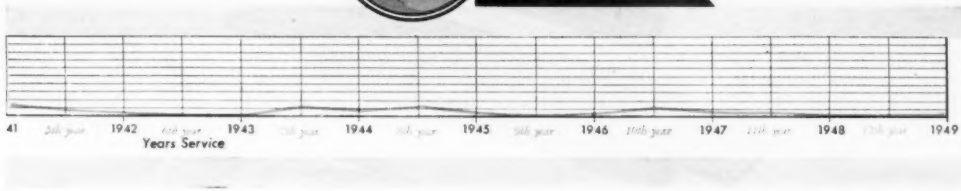
Call in a Gulf Lubrication Service Engineer and ask him to show you how Gulfcrest Oil can help you get improved lubrication and higher operating efficiency for your turbines. Write, wire, or phone your nearest Gulf office today.

Gulf Oil Corporation • Gulf Refining Company

Division Sales Offices:

Boston • New York • Philadelphia • Pittsburgh • Atlanta
New Orleans • Houston • Louisville • Toledo

GULF INDUSTRIAL LUBRICATION



"We Save About $5,000 A Year By Protecting Solenoids On Track Operated Switches"

"The solenoids on our track operated switches draw about 10 amperes. Formerly we tried to protect them with 10 ampere fuses. The fuses, however, were too large to prevent burning out of the coils when fault currents below the rating of 10 amperes were applied, continuously.

"In 1943 we started to replace these fuses with 2 ampere Fusetron dual-element fuses. We found that the time-lag of the Fusetron fuses permitted them to hold the initial current surge yet they would open if the solenoid circuit failed to operate properly.

"Now we have all our solenoids protected with Fusetron fuses and have reduced solenoid failures about 90%. This reduction resolves itself in a saving of about $5,000 a year when all factors involved in a failure are considered.

"We have obtained better protection on "KL" relay circuits by replacing 300 and 400 ampere fuses with 200 ampere Fusetron fuses. We had many failures of "KL" relay coils, fusing and burning open, due to the larger renewable fuses. The 200 ampere Fusetron fuses held the surge currents and protected the coil from fusing."

Ronald G. Thring, *Electrical Engineer*
Capital Transit Co., Washington, D. C.

With

Facts About FUSETRON Dual-Element FUSES

The fuse link element opens on short-circuit — the thermal cutout element protects on overloads — the result, a fuse with tremendous time-lag and much less electrical resistance.

They have the same degree of Underwriters' Laboratories approval for both motor-running and circuit protection as the most expensive devices made.

Made to the same dimensions as ordinary fuses — fit all standard fuse holders.

Obtainable in all sizes from 1/10 to 600 ampere, both 250 and 600 volt types. Also in plug types for 125 volt circuits.

Their cost is surprisingly low.

(FUSETRON is a trade mark of the Bussmann Mfg. Co., Division of McGraw Electric Co.)

Fusetron DUAL-ELEMENT Fuses

with their

10 Point Protection

1. Protect against short-circuits.
2. Protect against needless blows caused by harmless overloads.
3. Protect against needless blows caused by excessive heating — lesser resistance results in cooler operation.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. Protect motors against burnout from overloading.
6. Protect motors against burnout due to single phasing.
7. Give DOUBLE burnout protection to large motors — without extra cost.
8. Make protection of small motors simple and inexpensive.
9. Protect against waste of space and money — permit use of proper size switches and panels.
10. Protect coils, transformers and solenoids against burnout.

Stop Wasting Time and Money —

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

FUSETRON Dual-Element Fuses Give ALL-PURPOSE PROTECTION

One needless shutdown — or one lost motor — or one destroyed switch or panel — may cost you far more than replacing every ordinary fuse with a FUSETRON dual-element fuse.

Don't risk such losses — protect yourself by installing a FUSETRON dual-element fuse in every set of fuse clips throughout the entire electrical system.

Bussmann Mfg. Co., University at Jefferson
St. Louis 7, Mo. (Division McGraw Electric Co.)

Please send me complete facts about FUSETRON dual-element Fuses.

*Name*_____

*Title*_____

*Company*_____

*Address*_____

*City & Zone*_____ *State*_____ 549

NOW...

125 lb. S. P. BRONZE GLOBE, ANGLE and CHECK VALVES

Built to

LUNKENHEIMER

QUALITY STANDARDS

WANT a lower pressure valve to give the same dependable, low-cost service you get in higher pressure LUNKENHEIMER Valves?

Here it is—New Fig. 2140 Globe; Fig. 2141 Angle; Fig. 2142 Lift Check; Fig. 2444 Swing Check. These valves feature Lunkenheimer's traditionally fine design and sturdy construction, plus exclusive silicon bronze alloy stems which eliminate stem thread failure due to wear.

Whatever your requirements for lower pressure service, you'll find these new valves unequalled for dependability and true economy.

Full details, including illustrations and dimensions, are given in Circular No. 582. Ask your Lunkenheimer Distributor for it or write direct.

ESTABLISHED 1862

THE LUNKENHEIMER CO.

"QUALITY"

CINCINNATI 14, OHIO. U. S. A.

NEW YORK 13 CHICAGO 6

BOSTON 10 PHILADELPHIA 34

EXPORT DEPT. 318-322 HUDSON ST. NEW YORK 13, N. Y.

Fig. 2140
GLOBE
125 lb. S.P.
200 lb. W.O.G.

Your LUNKENHEIMER DISTRIBUTOR is stocking these new 125 lb. S.P. Bronze Valves. Call upon him for your original equipment, replacement and repair valve requirements.

Nowhere in the line is dependability more important than in Check Valves. These Checks function quickly and positively, seat accurately and tightly.

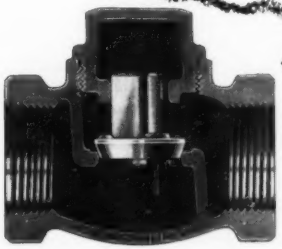


Fig. 2142
LIFT CHECK
125 lb. S.P.
200 lb. W.O.G.

Fig. 2144
SWING CHECK
125 lb. S.P.
200 lb. W.O.G.

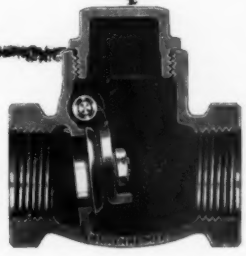


Fig. 2141
ANGLE
125 lb. S.P.
200 lb. W.O.G.

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company — "Bridgeport" — *Headquarters for BRASS, BRONZE, and COPPER*

Duplex Tubing for Lower Maintenance in Ammonia Refrigeration Systems

The rapid growth and penetration of mechanical refrigeration into industrial, commercial and domestic fields has introduced new corrosion and maintenance problems to operating engineers.

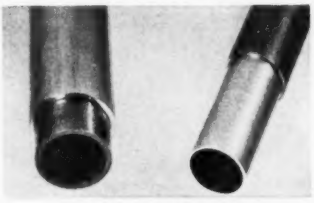
The selection of piping and tubing used in refrigeration and air conditioning requires careful consideration. In Freon refrigeration systems, copper tubing with brazed fittings gives satisfactory service since the copper resists corrosion from both Freon and water. Copper, however, is not satisfactory for direct contact with ammonia since it is attacked by the refrigerant.

The good corrosion resistance of steels to ammonia, both gaseous and liquid, explains the wide use of ferrous materials in the construction of equipment handling ammonia. However, steel tubes and pipes are subject to corrosion when immersed in brine, sea water or fresh water. This shortcoming can easily be overcome through the use of Duplex Tubing, consisting of non-rusting copper or copper-base alloy to the water side and steel to the ammonia side. This combination of Duplex Tubing is finding wide application not only for ammonia refrigeration, but, also, for equipment producing ammonia and its compounds.

The most popular combinations are low carbon steel combined with Copper, Admiralty or Red Brass for handling fresh water from rivers, lakes, ponds, and wells. Where sea water is used for cooling purposes, 80-20 Cupro Nickel, 70-30 Cupro Nickel, Duronze* IV (Arsenical Aluminum Bronze), Aluminum Brass, and Admiralty are preferred to copper because of their greater corrosion resistance to sea water. When the velocity of the sea water is comparatively high, Cupro Nickel, Duronze IV and Aluminum Brass are preferred because of their resistance to impingement corrosion.

Satisfactory Heat Transfer

Duplex Tubing is made by drawing together two tubes, one within the other. The close mechanical bond obtained in this manner results in very satisfactory heat transfer characteristics. Duplex composed of steel and copper has somewhat higher heat transfer properties than single walled steel tubing of the same size and wall thickness. The practical significance of this is that the designer can use the lower fouling factor for copper or copper-base alloys rather than the higher value customarily used for steel which rapidly develops an insulating coat of rust. This means that Duplex Tubes in smaller sized heat exchangers can sometimes replace larger units equipped with single-walled steel tubes. When units are retubed with Duplex Tubes of steel to copper or steel to copper-base alloys, greatly improved heat transfer properties may be anticipated, especially where excessive rusting (by water) is encountered on steel.



Duplex Tubing with outside tubes cut back to show construction.

Duplex Tubing of copper to the water side with steel to the ammonia side used in ammonia condensers. Courtesy Dow Chemical Company.

Duplex Tubing Reduces Maintenance and Replacement

Remarkable savings in maintenance and replacement have been reported by users of Duplex Tubing for ammonia refrigeration systems. A small dairy which installed copper lined steel Duplex Tubing 11 years ago reported that previous to the replacement, rust and scale had to be removed from the inside of the steel tubes every three months and the tubes themselves were replaced about every three years. Since the installation of Duplex Tubing, no cleaning has been necessary and the original Duplex Tubing is still giving excellent service.

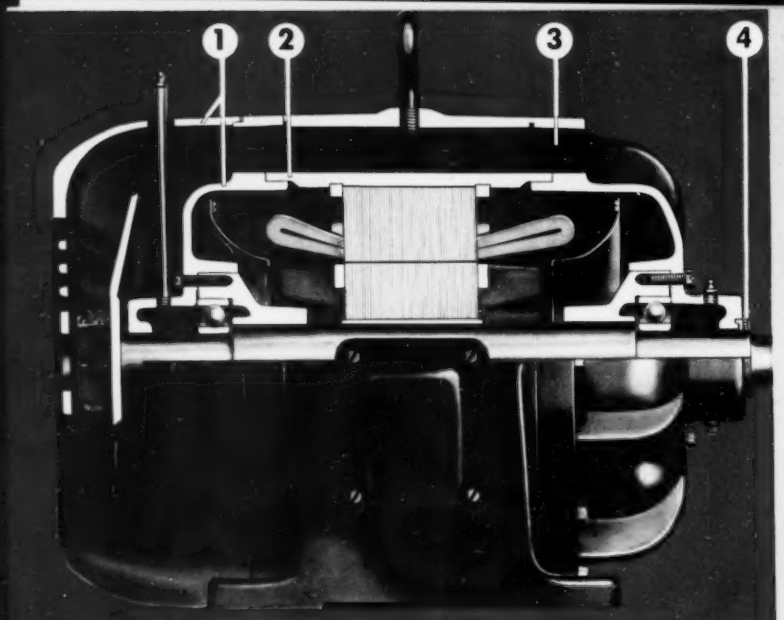
Write for "Duplex Tubing Technical Bulletin No. 746" and contact nearest Bridgeport office. *U. S. Pat. No. 2,093,380

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN. • ESTABLISHED 1865

Mills at Bridgeport, Connecticut, and Indianapolis, Indiana • In Canada: Noranda Copper and Brass Limited, Montreal

YOU CAN PUT A
TRI CLAD
MOTOR ANYWHERE
GENERAL ELECTRIC
HERE'S
WHY



The standard totally enclosed Tri-Clad features a *cast-iron* double-wall structure (1) that keeps outside air from electrical operating parts . . . machined-fit end shields (2) . . . large air passages (3), easy to clean . . . rotating labyrinth seals (4) that keep foreign matter from working in around the shaft. Note, too, the new corrosion-resistant G-E Textolite cooling fan is now standard on all 1- to 15 hp TEFC Tri-Clads.

You can put a *TRI CLAD* motor anywhere

YES SIR! The standard *Tri-Clad* open motor is a *cast-iron, dripproof* motor you can put anywhere that *any* open motor can be used—and in a lot of places where other open motors couldn't take it.

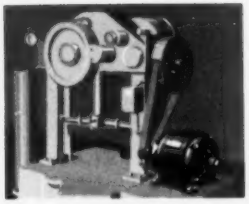
What's more, for the really dirty jobs—where air is laden with dust, or corrosive fumes—where metal chips and cutting fluids abound—the Tri-Clad totally enclosed motor gives you more protection, *inside and out*, than any other make of motor you can buy.

1,720,000 Tri-Clad motors, operating in every conceivable kind of plant, prove the far-reaching advantages of cast-iron construction . . . superior resistance to corrosion . . . rigidity that makes for permanent shaft alignment . . . inherent damping action that minimizes noise and damaging vibration. These motors prove, too, that Tri-Clad double-end ventilation simply has no equal for prolonging an open motor's useful life. Providing high-volume, relatively low-velocity cooling, this ventilating system keeps Tri-Clad motors *uniformly* "air-conditioned".

WANT MOTORS THAT CAN REALLY TAKE ABUSE? Tri-Clad motors in nearly all types and ratings are available for **IMMEDIATE SHIPMENT.** Contact your nearest G-E Office or write *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

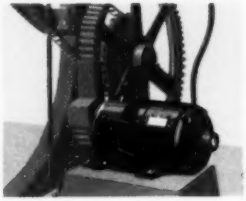
GENERAL ELECTRIC

There's a Tri-Clad motor for every industrial need!



G-E open (dripproof) induction motors for constant-load, constant-speed applications. From 1 to 2000 hp.

G-E totally enclosed motors for outdoor operation, in abrasive dusts, or corrosive fumes. From 1 to 1000 hp.



G-E gear-motors for low-speed operation. A normal-speed motor with built-in reduction gear. From ⅛ to 75 hp.

G-E synchronous motors for maintaining exact speeds or for correcting power factor. From 20 to 1000 hp.

YOU CAN'T BEAT
TRI CLAD
EXTRA
PROTECTION

NEWS

FROM THE POWER FRONT

AS REPORTED BY THE DEVELOPMENT ENGINEERS, FIELD SERVICE REPRESENTATIVES AND CUSTOMERS OF WORTHINGTON

Two 2¼ x 18 Worthington High Pressure Power Pumps furnishing 5000 lb. pressure for operation of two hydraulic presses at Canton Drop Forging & Mfg. Co. Each pump is fitted with Worthington Synchronized Suction Valve Unloaders for loading and unloading the pumps to conform with the capacity requirements for high pressure liquid.

Extraordinary Savings in Forging Production

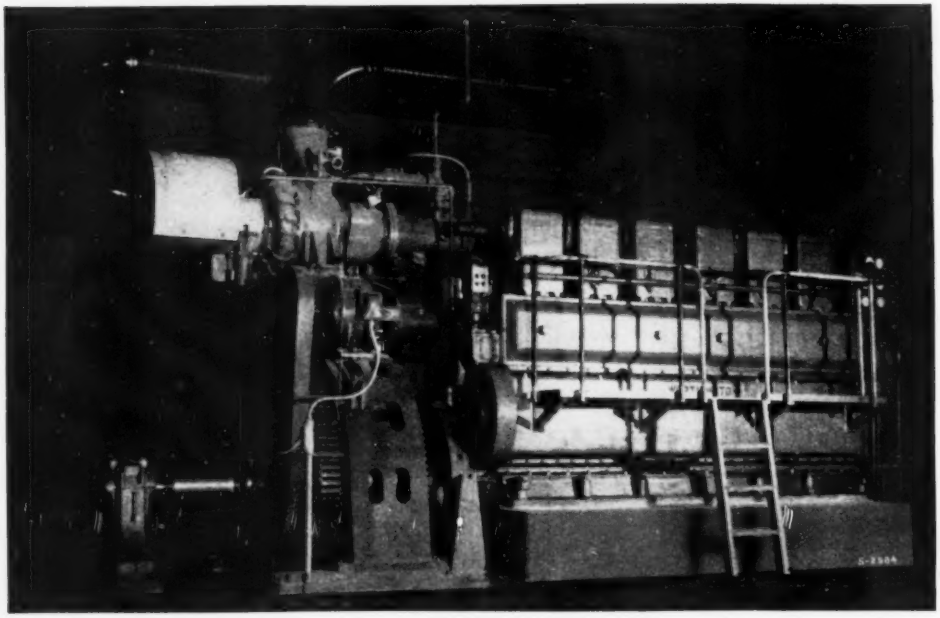
Propeller hubs forged in one operation, saving many hours of machining time and producing a material structure that is much denser and 50% lighter... aluminum airplane engine cylinder heads forged in one, instead of nine operations with similar advantages in structure and weight... are among the achievements of Canton Drop Forging & Mfg. Co.

In the case of the propeller hubs, savings of 275 lb to 375 lb of steel per forging are made by piercing the blade sections of the 3-way and 4-way hub forgings. In the case of the cylinder heads, unusual contours are produced satisfactorily.

In addition to conventional methods of production, this company uses patented procedures for production of various types of forgings from 2 lb to 2000 lb. In addition to its forging facilities, it operates one of the largest groups of high-powered equipment—including upsetters, presses and hammers—in the industry.

Two Worthington pumps furnish 5000 lb liquid pressure for operation of two hydraulic presses. They are 2¼ x 18 horizontal duplex double-acting. One press operates with four extrusion cylinders, exerting 1767 tons by one vertical cylinder and 950 tons by each of three horizontal cylinders. The other has five extrusion cylinders, exerting 1862 tons by one vertical cylinder and 994 tons by each of the four horizontal cylinders.

NEWS from the power front



Worthington SDH Diesel Engine in operation at Barton Mines.

Easier Maintenance . . . Faster Service for Barton

Barton Mines Corporation in North Creek, N. Y., is the largest producer in the U. S. of abrasive garnet. This iron-aluminum silicate has great hardness and maintains sharp edges in fracture. For these reasons, it is ideal for use on sandpaper and, when finely ground, as an abrasive for lens grinding in the optical industry, as well as for many other abrasive purposes.

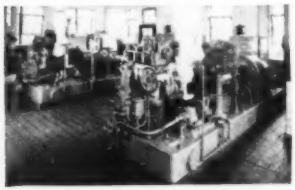
But it is a constant hazard in production. The sharp-toothed particles of abrasive garnet seep into machinery and eat away at metal parts.

Barton is now in the process of moving all its power generating equipment, now located in the same building as the mills, to a new power plant away from this abrasive garnet.

The new plant already houses 1 Worthington Type BB engine and 1 new Worthington SDH Diesel of 865 hp. The Worthington Type SDH engine drives a synchronous generator made by Electric Machinery Co., in Minneapolis, a subsidiary of Worthington.

Mr. E. F. Andrus, Chief Engineer of the mine, states that Barton selected Worthington because Worthington equipment is so easy to service should trouble arise. He says, "On the Worthington engine we can get at any main bearing in 15 minutes, whereas it takes us 24 hours to get at the main bearings on other engines."

"We are so far away from most service centers" he continues, "that for us the question of prompt delivery of spare parts or access to technical advice is a major factor. One of our experiences with Worthington has been, for example, that when we sent them an order for a new set of wrist pins, we had the new ones here within 10 days . . . once we needed a new crankshaft and they were ready for immediate shipment."



Two 250 KW Worthington turbine generators at St. Joseph's Retreat, Dearborn, Mich.

Only $30.00 for Doctoring These Turbo-Generator Units

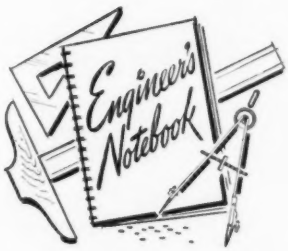
St. Joseph's Retreat, a hospital in Dearborn, Mich., gets its power from two 250 kw Worthington—Moore steam turbo-generators.

These units were installed in 1940, replacing steam engines, and have been in continuous service ever since then. During that time, the total cost of repair parts has amounted to only $249.00—less than $30.00 a year.

This power plant was designed and erected under the supervision of Harry J. McFarland, M.E.

Worthington Pump and Machinery Corporation
Harrison, N. J.

NEWS



Better Materials Increase Feed Pump Reliability

Twenty years ago, there existed one and only one standard insofar as boiler feed pump materials were concerned. This standard—cast-iron castings and bronze internal fittings—was relatively satisfactory in the days when operating pressures and temperatures were low and when boiler feed water treatment did not introduce the problems faced by the pump designer of today. However, pressures and temperatures grew apace and both designers and operators discovered the inadequacy of the single material standard.

Fortunately, the metallurgical engineer was introducing developments which enabled the pump designer to take advantage of better materials. These better materials refer to the great number of stainless steels, each with its own qualities of toughness, strength and resistance to corrosion and erosion.

The internal fittings of boiler feed pumps were the first to undergo certain definite changes away from the stereotyped old standards of bronze trim under all conditions. For instance, as far back as 10 years ago, it became the practice of our company to furnish 13% chrome stainless steel impellers whenever operating temperatures exceeded 250°F. or when there had been evidence of possible corrosion, or when impeller diameters exceeded 10 inches when operating at speeds of 3560 rpm. The use of 13% chrome stainless steel instead of bronze for temperatures over 250°F. was predicated on the excessive expansion of bronze impellers under these temperatures, and the consequent stresses in impeller hubs, crushing of these hubs and bowing of the shaft. The diameter limitation for bronze impellers was based on the fact that excessive centrifugal force action will stretch the impeller hub in addition to expansion, causing loosening of the impeller.

Insofar as the resistance to corrosion was concerned, the use of 13% chrome stainless steel impellers was introduced before very definite information on the effect of feedwater pH was available. In other words, 13% chrome stainless steel impellers were applied frequently on the strength of evidence such as graphitization of cast-iron castings or other symptoms of corrosion. Today, very definite limits have been established for the use of bronze impellers insofar as corrosion resistance is concerned. Thus, bronze fittings are used for temperatures under 250°F. only if pH is neutral to 8.5 and water is not known to be excessively corrosive.

A definite impetus toward a greater utilization of stainless steel for boiler feed pump parts and casings was given by the recent findings of an investigation conducted by the Boiler Auxiliary Sub-Committee of the Edison Electric Institute to determine the cause of the rapid pump deterioration experienced in many of the higher pressure power plants.

The possible range of selection of corrosion resistant stainless steels is relatively wide and includes both the straight chromium steels and the so-called austenitic, chromium nickel steels. In the former type, the chromium content may be at the 5, 9, or 13% level. In the latter case, the composition range may extend from the familiar 18% chromium, 8% nickel type to the higher 25% chromium, 20% nickel type adopted by the U. S. Navy.

In the choice between austenitic and non-austenitic stainless steels, the latter is preferred because austenitic steels have a coefficient of expansion approaching that of bronze and 50% greater than that of carbon steel or of the lower chromium level steels. This difference in coefficients of expansion could lead to operational difficulties due to the interruption of axial alignment. Therefore, it was recognized quite early that the use of 18-8 or higher chromium content stainless steels was fraught with a greater danger of operational trouble than that of 5% or 13% chromium steel.

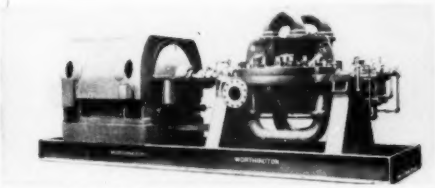
Today, whenever the water is known to have excessive corrosion action, casings are made of either 5% or 13% chromium steels.

The table summarizes present average practice in regards to material selection, subject to modifications with additional experience.

24.9.8

Present Average Practice in Selection of Materials for Boiler Feed Pumps

	Casing	Fittings	Maximum Temperature	Use
1.	Cast Iron	Bronze	250 F	pH neutral to 8.5, unless water is known to have corrosive action.
2.	Cast Iron	13% Chromium Stainless Steel	350 F	Any pH, unless water is known to have excessive corrosive action.
3.	Carbon Steel	Bronze	250 F	Seldom used for boiler feed service—only where water is definitely known *not* to be corrosive.
4.	Carbon Steel	13% Chromium Stainless Steel	400 F	pH above 8.5, unless water is known to have corrosive action.
5.	5% or 13% Chromium Steel	13% Chromium Stainless Steel	Any temperature normally encountered	Any pH and where water is corrosive or previous trouble reported.



Worthington 6" UX-2 Centrifugal Volute Pump, with Chrome-Steel Casing. Exterior appearance of radially split double casing boiler feed pump

FULL LINE . .
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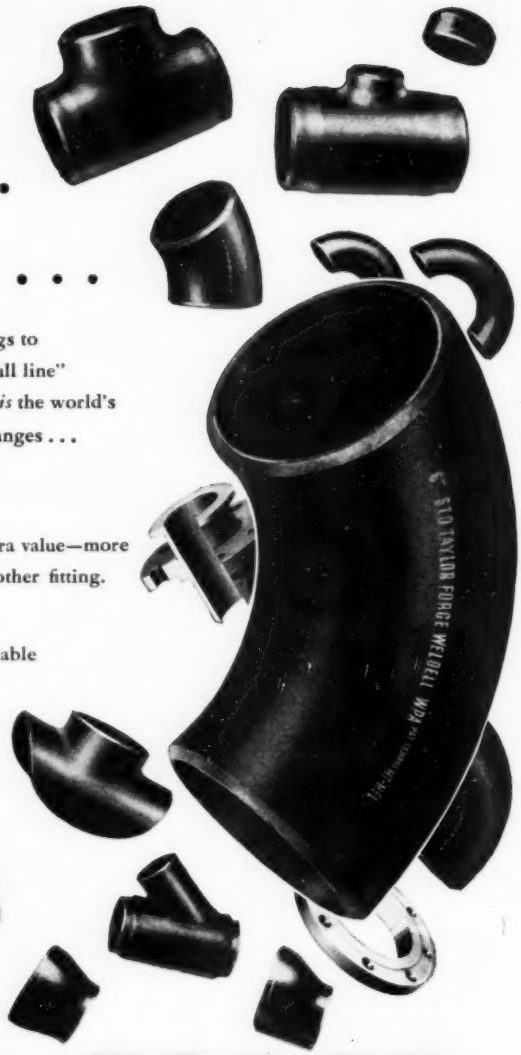
FULL SERVICE . . . .



We have repeatedly urged users of welding fittings to accept no less than the *full line.* When we say "full line" we don't just mean its *completeness* . . . though it *is* the world's most complete line of forged steel fittings and flanges . . . and it *does* contain the widest range of types, sizes, weights and materials.

When we say "full line" we mean full value—extra value—more and better features than can be found in any other fitting.

The technical brains and forging skills which conceived these extra values continue to be available to you through the Taylor Forge organization, and through the Taylor Forge distributor who is your industrial neighbor.

Since Taylor Forge welding fittings "have everything," why compromise on less than the best?

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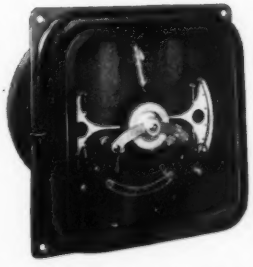
with Allis-Chalmers ROCKING CONTACT Generator Voltage Regulator



Type 366 *Rocking Contact* Generator Voltage Regulator. In motion only when change in excitation is required by voltage variation.

YEARS of trouble-free service . . . and you get instant response, accuracy, low maintenance besides. Here's how:

Design is simple, and although the Rocking Contact Regulator is a watch-like instrument, it has been built for rugged industrial use. No complex adjustments, no vibrating contacts, no gliding friction to make it a maintenance problem.

Regulation is quick, accurate because it operates directly in the exciter shunt field circuit . . . without relays. Generator rheostat losses are reduced to a minimum.

Rocking Contact Regulators are available for both a-c and d-c generators of any size and speed, for either parallel operation or unit control. Call your nearby Allis-Chalmers office, or write direct.

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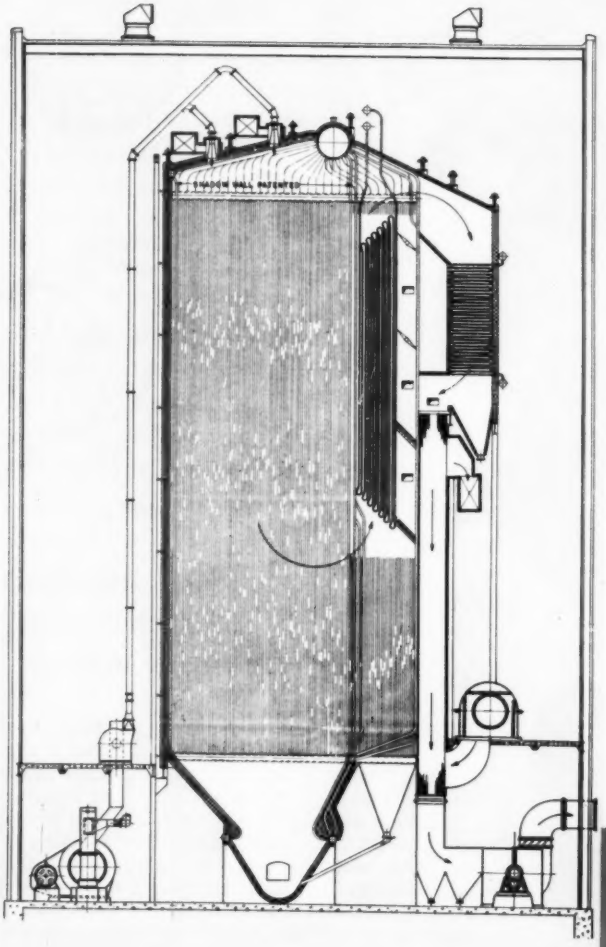

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. . . a copy of 97-page Engineering Bulletin No. 44-B containing valuable information on preparation of pulverized fuel and steam generating plants.

ENGINEERING SERVICE

KVS offers a complete service in design, building and erecting complete steam generating plants under one responsibility. KVS engineers are available for consultation on your requirements.

Steam Generating Unit...

RADIANT TYPE...TOP FIRED •

A Modern Design for

PULVERIZED COAL

The drawing (Left): KVS pulverized-coal-fired steam generator having a single steam drum, water cooled furnace, pendant superheater, bare tube economizer and tubular air preheater.

TOP FIRED: L-o-n-g flame travel for complete combustion. "Talcum-Powder" pulverization: 85 percent through 200 mesh, less than ½ percent unburned carbon, instant response to controls.
RADIANT HEAT furnace, quick steaming. Tangent-tube side and end walls, exclusive 360° Shadow Wall at the second row of furnace tubes.

For bituminous . . .
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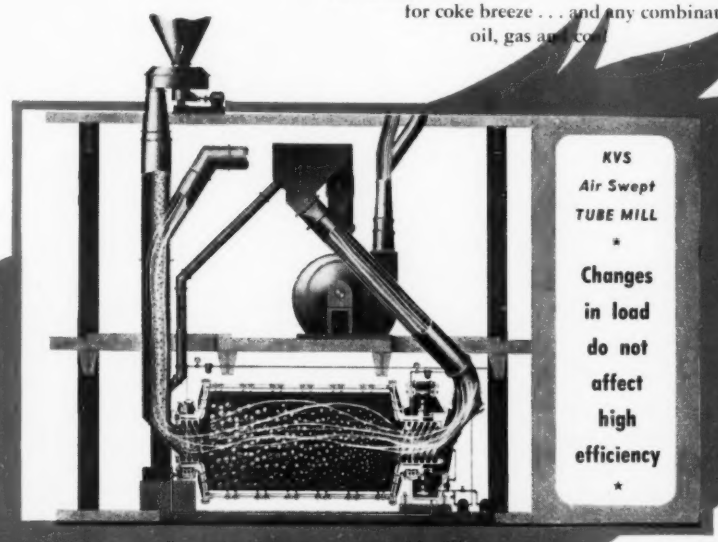
oil, gas and coal



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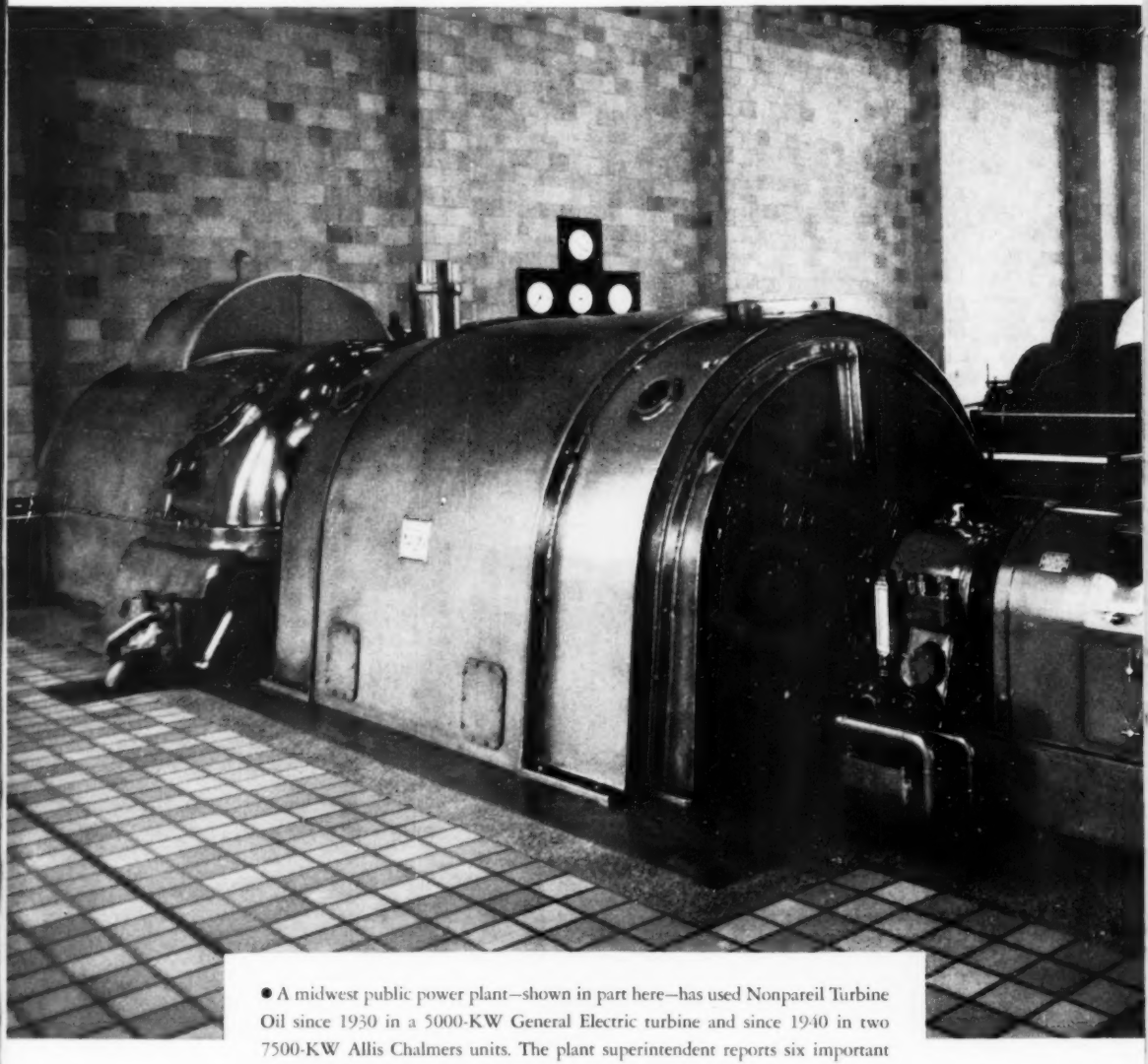


• A midwest public power plant—shown in part here—has used Nonpareil Turbine Oil since 1930 in a 5000-KW General Electric turbine and since 1940 in two 7500-KW Allis Chalmers units. The plant superintendent reports six important savings made with Nonpareil.

STANDARD

STANDARD OIL COMPANY (INDIANA)

..turbine lubrication

NONPAREIL
Turbine Oil
"Will outlast your turbine"

Nineteen years' service by Nonpareil Turbine Oil has given ample evidence of Nonpareil's great saving ability in a midwest public power plant. The superintendent reports:

1. **No oil-replacement fills**
2. **No extra oil batches**
3. **No sweetening of oil**
4. **No oil-treating losses**
5. **No cleaning of oil systems**
6. **No repairs due to faulty lubrication**

In addition, the superintendent states that the quantity of make-up oil has been held very low—less than an average of 12 gallons per year needed for 3 turbines.

Why not take advantage of Nonpareil's great saving ability? This unique turbine oil can reduce oil maintenance and lubrication troubles to a rock-bottom low in your plant. Its ability to do this is backed by a written guarantee.

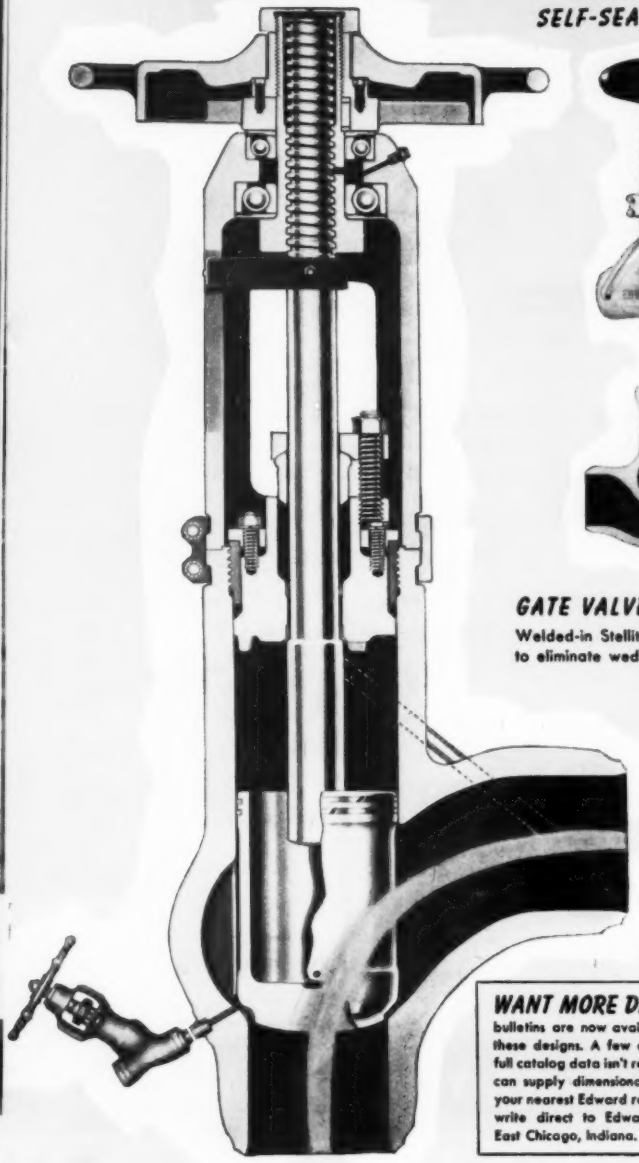
Nonpareil is the only turbine oil that is guaranteed in writing not to increase in acidity above a neutralization number of 0.15 mg. KOH/gm. That is your insurance against troubles, your assurance of lubrication savings. A Standard Oil Lubrication Engineer will be glad to give you facts and figures from other Nonpareil performance records.

Standard Oil Company (Indiana), 910 S. Michigan Ave., Chicago 80, Ill.

STANDARD OIL COMPANY (INDIANA) STANDARD

They're New!

NEW PRESSURE SEAL BONNET VALVES.. NEW FORGED STEEL GLOBE VALVES.. NEW IMPACTOR HANDWHEELS..

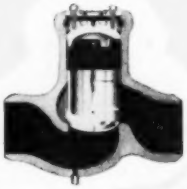


SELF-SEALING BONNET JOINTS, 30% MORE FLOW

Now you can get Edward pressure-seal bonnet valves in gate, globe or angle patterns for stop, check or non-return service. New features for lower and lower pressure drop have been built in—and **proved.** On no other valve series is there more proven flow data.

EDWARD PATENTED EVALTHRUST YOKE BUSHING

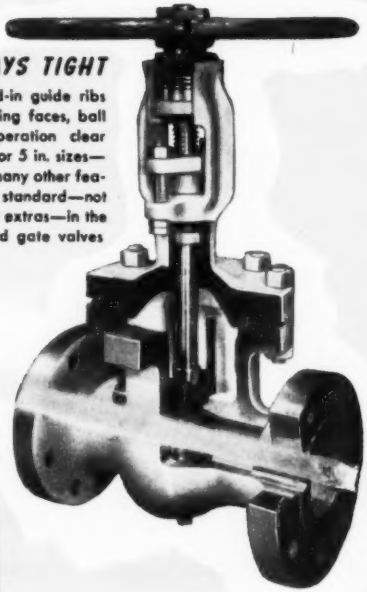
and Impactor handwheel for easiest closing in cramped locations is standard on stop and non-return series. So is closure indicator.



ON CHECK VALVE, left, and non-return valve, far left, note new enclosed dash-pot disk, Edward Equalizer for high disk lift and free flow passage. The whole series is regularly built in chrome-moly steels for stability at high temperatures.

GATE VALVE THAT STAYS TIGHT

Welded-in Stellited seats, welded-in guide ribs to eliminate wedge drag on seating faces, ball bearing operation clear down to 4 or 5 in. sizes—these and many other features are standard—not added cost extras—in the new Edward gate valves



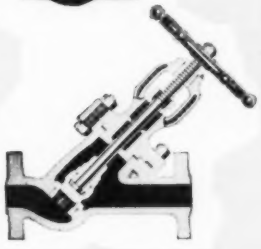
WANT MORE DATA? Special bulletins are now available on most of these designs. A few are so new that full catalog data isn't ready yet, but we can supply dimensional drawings. Ask your nearest Edward representative, or write direct to Edward Valves, Inc., East Chicago, Indiana.

A WHOLE NEW GROUP of Edward Steel Valve Designs

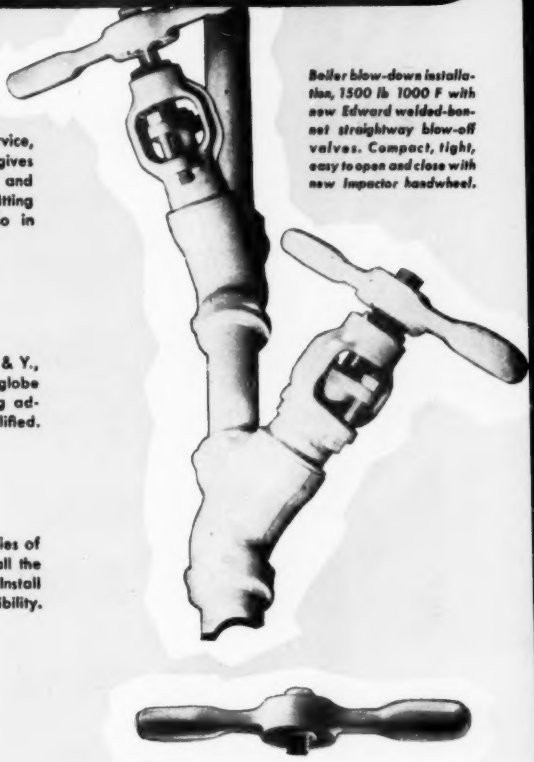
..NEW GAGE VALVES..NEW WELDED BONNET UNIVALVES..NEW BLOW-OFF VALVES...NEW GATE VALVES

FINE REGULATION ON GAGE LINES For gage and meter service, the redesigned Edward Fig. 152 valve gives close flow regulation with small seat port and longer seat-stem contact area. New form fitting T-Handle. Rated 4000 lb W.O.G. Also in 12% Cr. and 18-8 stainless steels.

ALL-PURPOSE SMALL GLOBE VALVE Here's a new O. S. & Y., union bonnet, bolted gland forged steel globe valve for a multitude of services. Packing adjustment or replacement greatly simplified. Rated 800 lb, 750 F.



BLOW-OFF FLEXIBILITY A new series of 300 lb O. S. & Y. blow-off valves with all the design features of high pressure valves. Install them in any position for greatest piping flexibility.



Boiler blow-down installation, 1500 lb 1000 F with new Edward welded-bonnet straightway blow-off valves. Compact, tight, easy to open and close with new Impactor handwheel.

NEW, EASIER CLOSING Now the Edward Impactor handwheel, modernized and improved, is available on many small valves as well as large. Easy-to-grip cross bar delivers 2.8 times the closing load of ordinary handwheels. No wrenches or extension bars needed.

NEW WELDED-BONNET UNIVALVE

Already lowest in pressure drop among forged steel globe valves, Edward patented welded bonnet Univalves have been modified to give even less resistance to flow, less wear-producing turbulence. For top temperature service and up to 2500 lb pressure, here is the valve that offers the most.

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First for Fans

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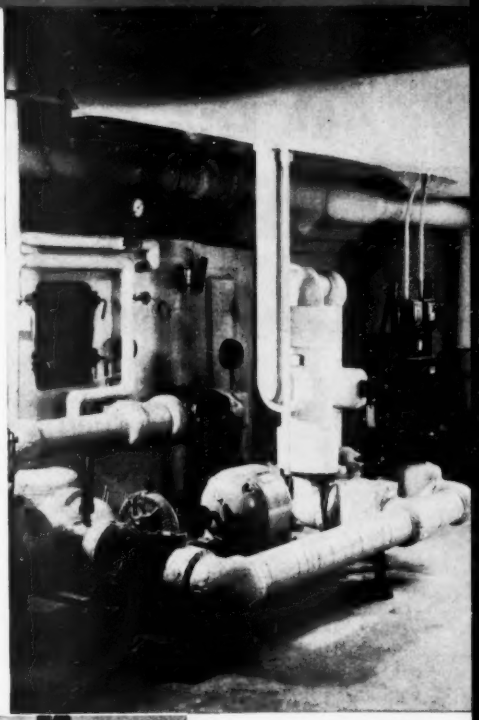
"Capacity to produce desired results" — *Webster*

PRESENT-DAY hospital design recognizes the very real necessity of adequate air conditioning. Thus, the progressive planning of the Hartford Hospital included "Buffalo" fans, pumps and air conditioning units as part of its far-sighted program.

This dependable air conditioning keeps the vital fourth-floor operating rooms free of dust, dirt, draft and noise. "Buffalo" Air Control does an important job on the thirteenth floor, too — where the Central Sterile Supply Room and Intravenous Solutions Manufacture Department is located. And on the ground floor, "Buffalo" equipment dissipates food odors from the Main Kitchen and keeps personnel comfortable, alert and efficient.

Hospitals are daily finding new uses for air conditioning. Removing explosive anesthesia gases—aiding therapy—improving the germ-killing effectiveness of ultra violet lamps—are but a few.

Whether you are concerned with hospital, office building or plant, don't leave "Buffalo" Air Conditioning out of the plans. Contact your "Buffalo" representative for the Air of Efficiency your building needs.



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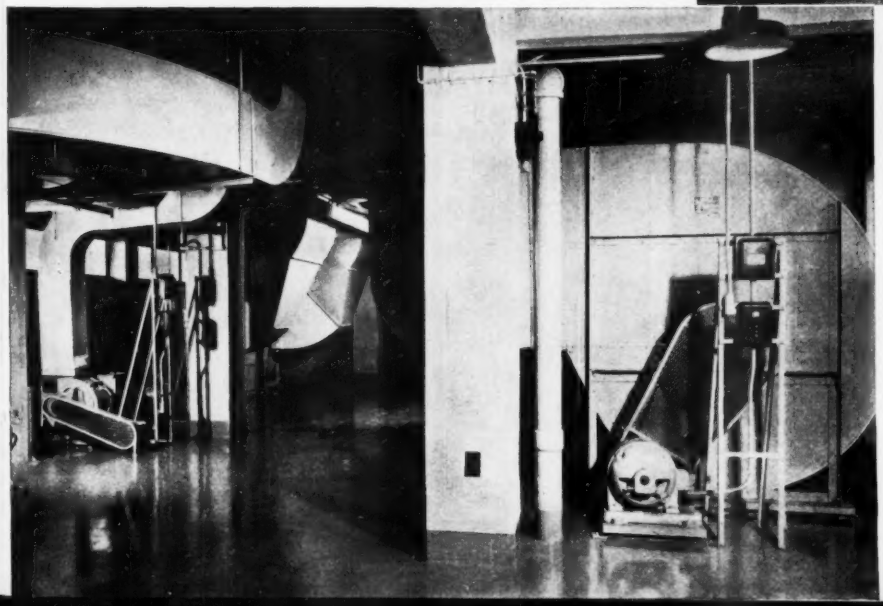
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.
Branch Offices in all Principal Cities



"Buffalo" Air Conditioning Units like the one above, and "Buffalo" Pumps, provide clean air automatically and exactly controlled as to desired humidity and temperature.

Quiet-running "Buffalo" Limit-Load Fans supply the vital air for processing and distributing in the Hartford Hospital—on continuous service, day and night.

HAGAN controls

AT THE McKEESPORT PLANT OF KELSEY-HAYES WHEEL COMPANY

Kelsey-Hayes Wheel Company, manufacturer of steel wheels for automobiles, farm implements, etc., is one of the companies which have acquired manufacturing facilities in the Pittsburgh area in recent years.

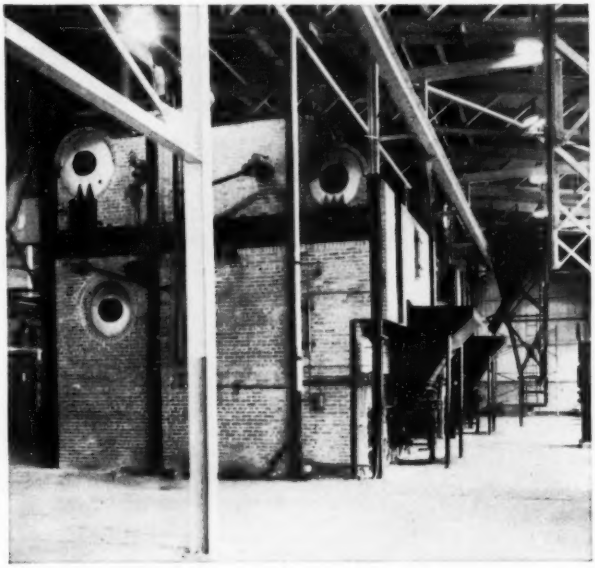
The plant purchased by them was previously used for certain work of Jones & Laughlin Steel Corporation, and before that was occupied by the McKeesport Tin Plate Co. The problem confronting Kelsey-Hayes was to get in production quickly, and to continue production while virtually constructing a new plant within the walls of the old. This work is being handled by the Austin Company, Cleveland engineers and builders.

One of the first steps was the construction of a new steam plant, since the new type of operation requires better heating facilities. In addition, some steam is required for the pickling tanks. It was necessary also to provide for expanding boiler room facilities to keep pace with steam demand when the plant is in full production.

In its present stage, the plant has two stoker-fired, 160-lb. boilers, with capacities of 25,000 lb./hr. and 45,000 lb./hr. respectively. Both boilers are equipped with Hagan Automatic Combustion Control and Hagan Ring Balance Boiler Meters.

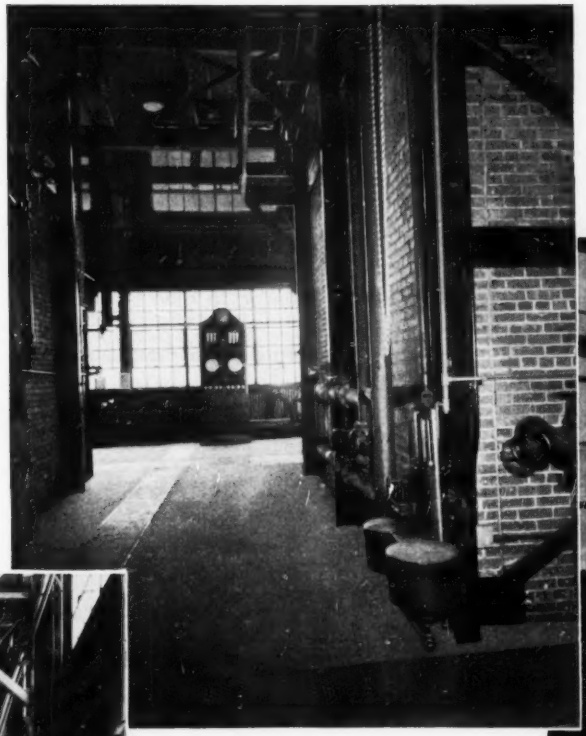
These meters are the three-pen-type, providing records of steam flow, air flow, and flue gas temperature on a single chart. Steam flow is also shown on a strip indicator, and is continuously totalized by the Hagan Ring Balance integrator with which each meter is equipped.

For full information on Hagan Controls and Hagan Ring Balance Flow Meters, write to Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.

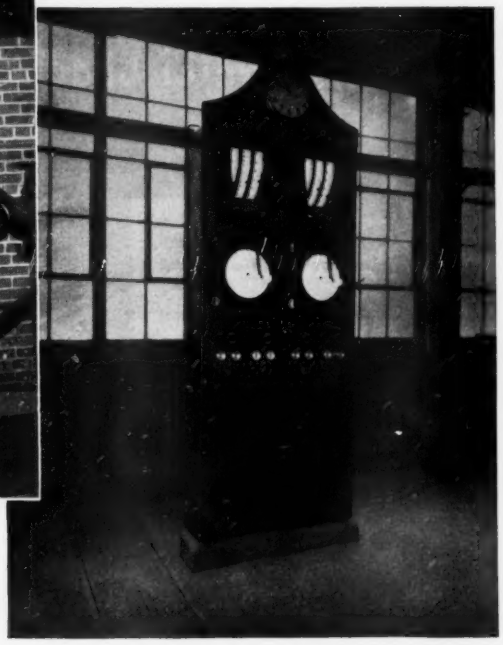


View of the first two new boilers at Kelsey-Hayes. R. D. Craighead is General Foreman in charge, F. V. Hopke is boiler room foreman.

and meters—



View between boilers, looking toward control panel. Hagan Balanced Float Controller is shown at corner of boiler on the right. This element of the Hagan Control System operates uptake damper.



Control panel showing Hagan Controls and Hagan Ring Balance Boiler Meters. Meters record flue gas temperature also, and are equipped with strip indicator for steam flow.

HAGAN
HALL
BUROMIN
CALGON

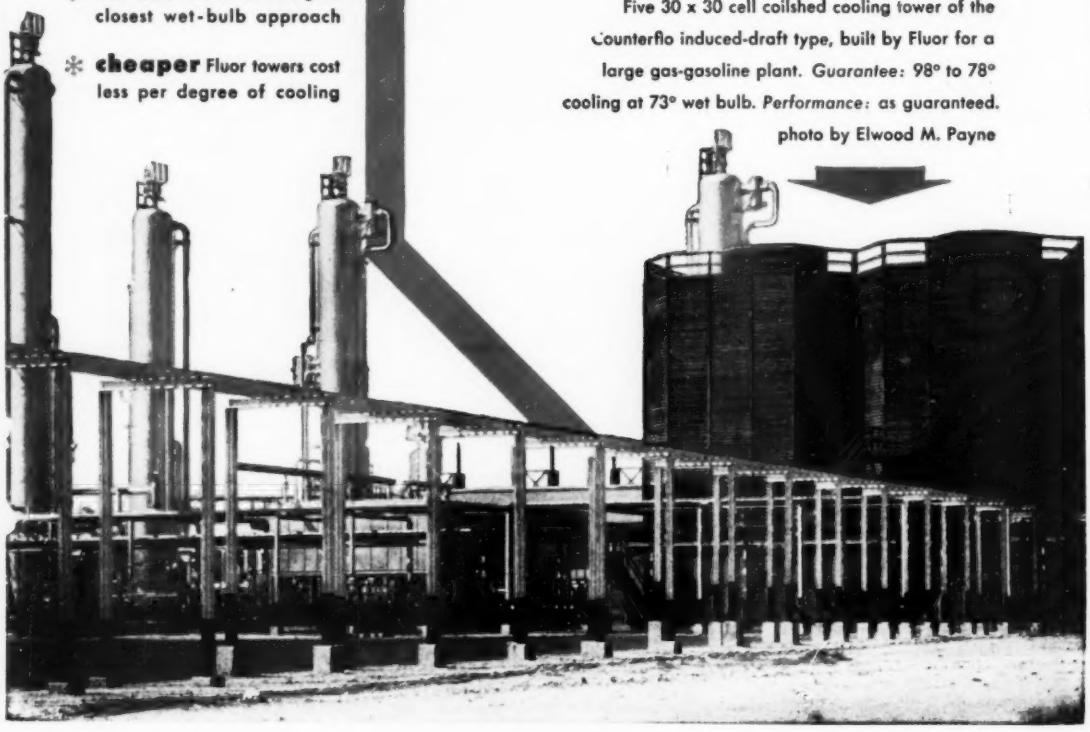
HAGAN CORPORATION

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
THRUSTORQ FORCE MEASURING DEVICES

every **FLUOR** counterflo cooling tower delivers colder water cheaper

Every Fluor *Counterflo* tower cools to the guaranteed temperature. Does this *insured performance* cost you more? No! Fluor towers are prefabricated in standard cell sizes for low erection costs—and engineered to give maximum cooling per fan horsepower.

* **colder** Fluor towers give closest wet-bulb approach
* **cheaper** Fluor towers cost less per degree of cooling

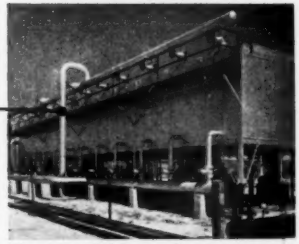


Five 30 x 30 cell coilshed cooling tower of the Counterflo induced-draft type, built by Fluor for a large gas-gasoline plant. *Guarantee:* 98° to 78° cooling at 73° wet bulb. *Performance:* as guaranteed. photo by Elwood M. Payne

aerator towers

Fluor Aerator cooling towers, have distinctive economy features and are most practical in certain cooling applications.

fin • fan units

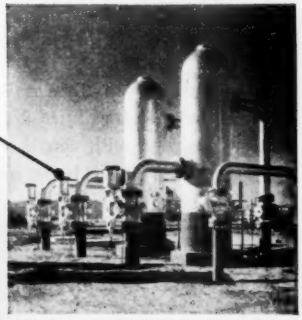


Fluor air-cooled heat exchangers are more economical where make-up water is expensive, where water has bad scaling characteristics, and where the temperature of liquid to be cooled is relatively high. (Manufactured and sold by Fluor and Griscom-Russell Co.)

pulsation dampeners

Fluor pulsation dampeners remove destructive vibrations and instrument irregularities caused by pulsative gas flow.

gas cleaners



The Fluor gas cleaner, already well-known for efficient cleaning, has been redesigned to give still better performance.

mufflers

Fluor mufflers, redesigned to incorporate pulsation-dampener principles, reduce exhaust-line noises to less than the mechanical noises of the compressor room.

BE SURE WITH FLUOR

FLUOR

THE FLUOR CORPORATION, LTD.

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HOUSTON • KANSAS CITY • BOSTON • TULSA
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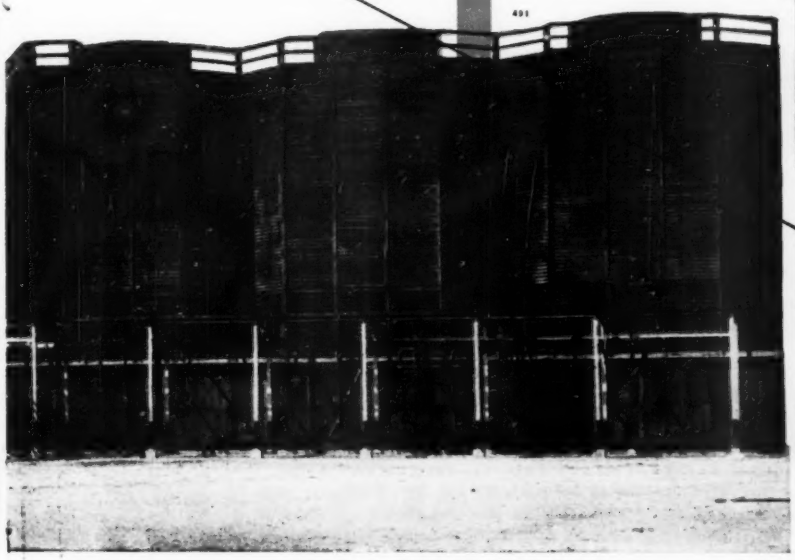
SAVE YOUR COMPANY MONEY

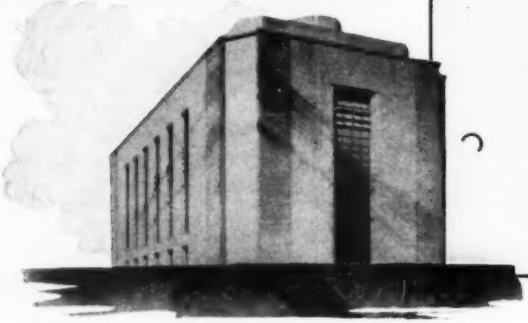
Before buying a cooling tower, we urge you to look at the engineering *facts* presented in the new booklet "Colder Water Cheaper". Write us for your copy.

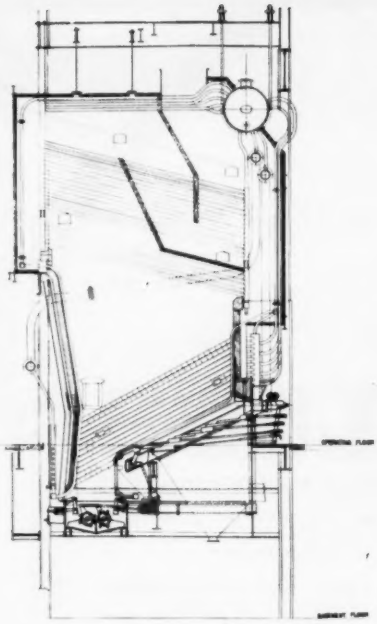


Higher Efficiency On Lower Grade Fuels Made Available to Government Heating Plant

● *Modern heating plant in nation's capital has two water cooled Taylor Multiple Retort Underfeed Stokers. These units are designed to handle 150,000 lbs. per hour normal steam flow, and 240,000 lbs. per hour peak load. Furnishing steam heating to the Government building system, these stokers offer the ultimate in fuel flexibility.*

Performance of these two units has been so satisfactory that a duplicate unit has just been ordered.





POWER PLANTS throughout coal burning areas are installing the Taylor Stoker to permit the burning of today's coals with freedom from smoke and objectionable stack discharge.

Designed with simplicity as the keynote, Taylor has lower boiler outages, fewer moving, longer wearing parts. A unique precision pusher stroke control mechanism and better air flow are two more exclusive Taylor features that aid in giving you efficient, low-cost steam generation and trouble-free operation.

Backed-up by more than 45 years of engineering "know-how," these and other distinctive advantages make Taylor the time-tested, proven, economy stoker for both original and repeat installations.

Before you decide on any fuel-firing equipment for *your* power plant, see for yourself why the "trend is toward Taylor"—it's the stoker of proven performance.

FREE

This "fact-packed" booklet on the improved Taylor Stoker.

If you aren't up-to-date on stokers, write for your copy of this descriptive booklet today!

TAYLOR STOKER

A PRODUCT OF

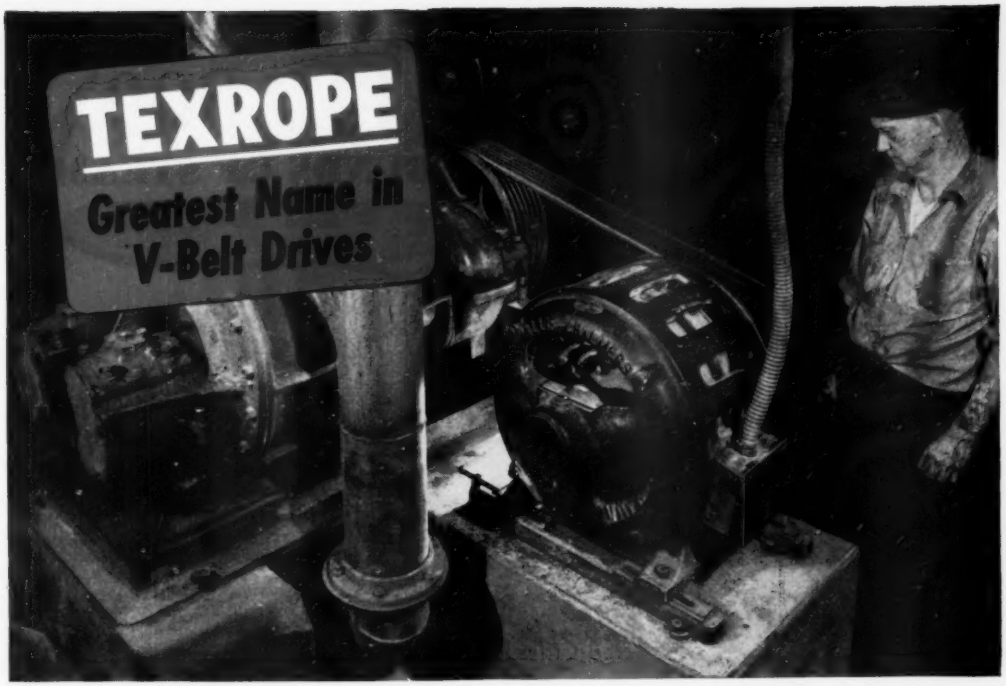
AMERICAN ENGINEERING COMPANY

2400 ARAMINGO AVENUE, PHILADELPHIA 25, PENNSYLVANIA

New York Office—75 West Street, N.Y., N.Y.

In Canada: *Affiliated Engineering Corporations Limited, Montreal and Toronto*

OTHER Æ PRODUCTS—Perfect Spread Stokers—Lo-Hed Electric Hoists & Car Pullers—Marine Deck Auxiliaries—Hele-Shaw Fluid Power



"No Upkeep Now"

BELT SLIP ELIMINATED, BEARING DAMAGE STOPPED, POWER WASTE ENDED WHEN *TEXROPE* V-BELT DRIVE REPLACES FLAT BELT.

CHIEF PLANT ENGINEER in this midwest plant says, "The old flat belt on this blower drive was twelve inches wide on twenty foot centers. Not only was it heavy but it also absorbed a lot of power.

"Besides that, dust made the belt slip constantly. We had to keep the belt so tight that it ruined bearings. And slipping would burn the belt. Maintenance on our old flat belt drive cost us hundreds of dollars every year.

"Four years ago an Allis-Chalmers representative recommended this *Texrope* drive. It doesn't slip at all, doesn't hurt the bearings and we haven't spent a cent on it. I wish we had changed to a *Texrope* drive years sooner."

Money-saving performance like this is one of the reasons why more *Texrope* industrial V-belt drives have been installed since 1926 — when Allis-Chalmers originated the multiple V-belt drive — than any other kind.

The *Texrope* line gives you practically everything you need for any V-belt drive . . . V-belts, standard and *Vari-Pitch* sheaves and speed changers . . . all from one reliable source. You can engineer 90% of all V-belt drives yourself with the help of the *Texrope* Pre-engineered Drive Manual. See your A-C Authorized Dealer or District Office or write for Bulletin 20B6956. Also in Sweet's.

Texrope Super-7 V-belts result from the cooperative research of Allis-Chalmers and B. F. Goodrich; and are sold only by A-C dealers and offices. *Texrope* and *Vari-Pitch* are Allis-Chalmers trademarks. A 2648

Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and District Offices throughout the country.

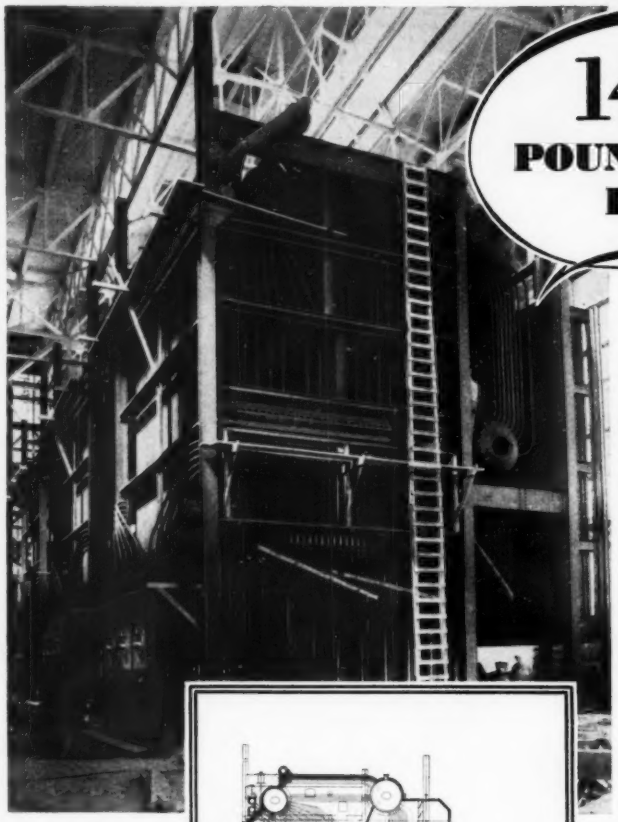
MOTORS — ½ to 25,000 HP and up. Matching Allis-Chalmers Control.

TEXROPE — Belts in all sizes and sections, standard and Vari-Pitch sheaves, speed changers.

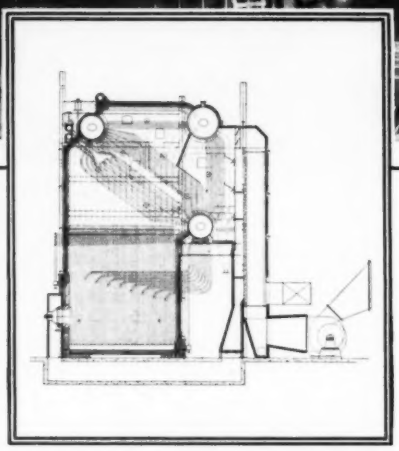
PUMPS — Integral motor and coupled types. Sizes and ratings to 2500 GPM.

ALLIS-CHALMERS, 952A SO. 70 ST.
MILWAUKEE, WIS.

ALLIS-CHALMERS



140,000
POUNDS OF STEAM PER HOUR



Number of Erie City Steam Generators.....3

Pounds of Steam/Hr..140,000

Design Pressure.....450 lbs.

Operating Pressure...425 lbs.

Steam Temperature..725° F.

Heating Surface—
Erie City Boiler
12,610 Sq. Ft.
Erie City Water Walls
2,312 Sq. Ft.
Erie City Air Heater
12,000 Sq. Ft.

Final Exit Gas Temp..401° F.

Method of Firing
Gas and Oil

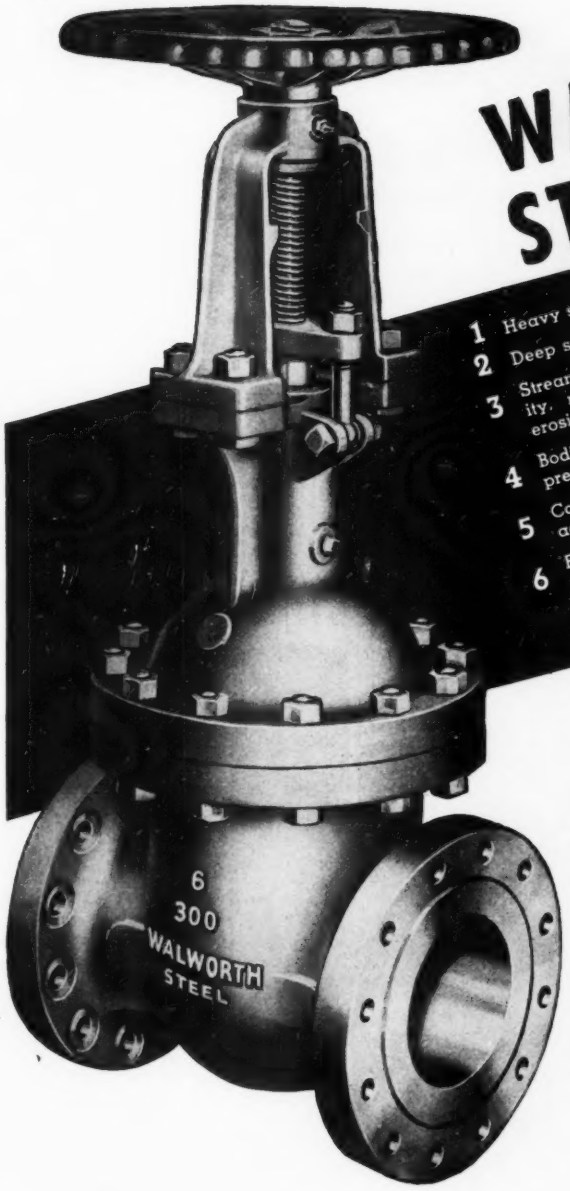
STEAM POWER PLANT EQUIPMENT

Complete Steam Generators • Type C 3-Drum Boilers • Type VL 2-Drum Boilers • The "Economic" Boiler with or without Water Walls • Welded H. R. T. Boilers • Welded Steel Heating Boilers • Coal Pulverizer • Underfeed and Spreader Stokers • Welded Pressure Vessels for the Process Industries.

ERIE CITY
SINCE 1840

ERIE CITY IRON WORKS • ERIE, PA.

You get all these BIG features in WALWORTH STEEL VALVES



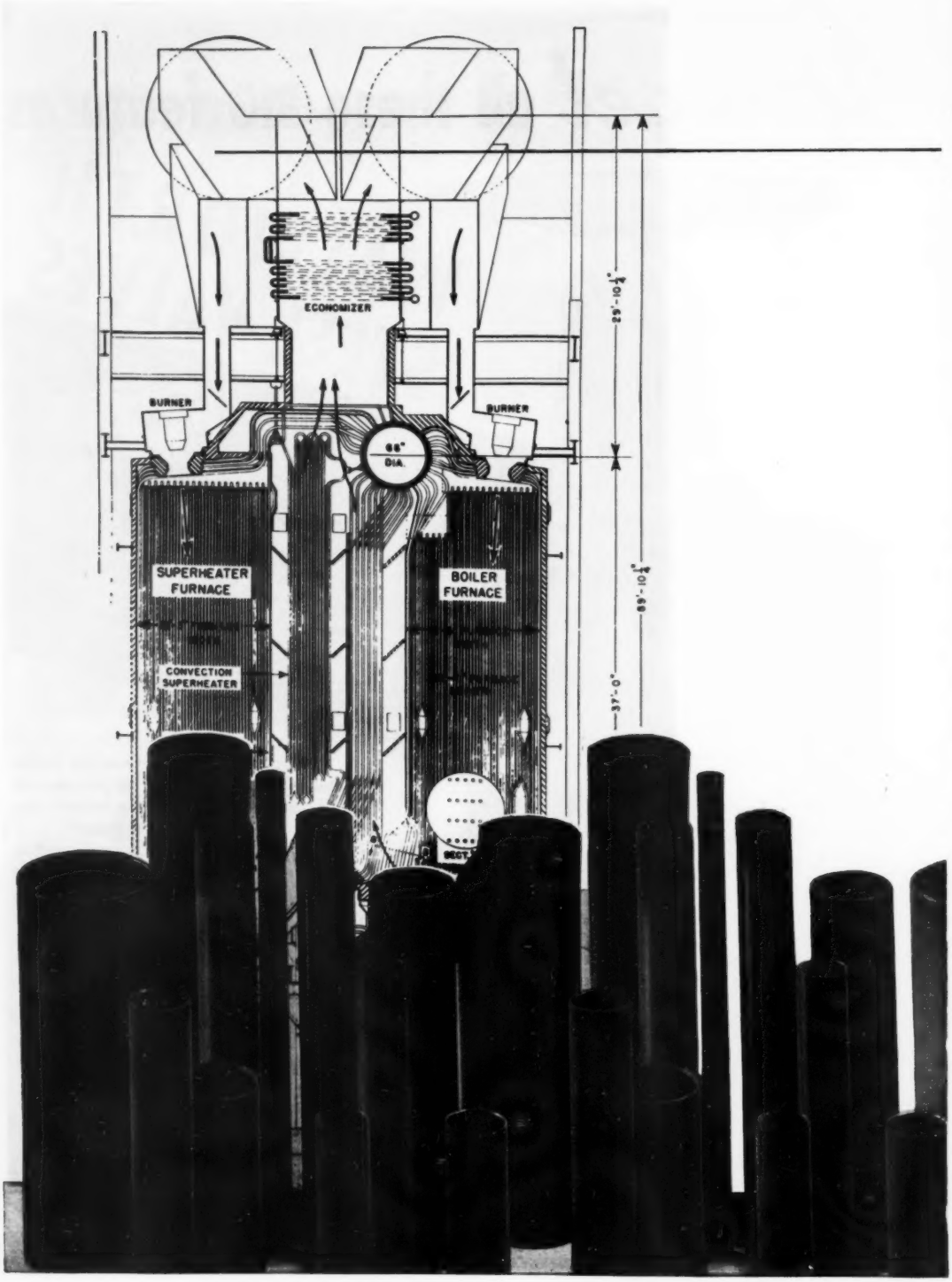
1. Heavy steel walls for extra strength and protection.
2. Deep stuffing boxes to eliminate costly leaks.
3. Streamlined ports to make possible a high velocity, non-turbulent flow, and reduces possible erosion.
4. Bodies and bonnets engineered to withstand pressure and minimize distortion.
5. Cast body guide rib faces, machined to insure accurate disc centering.
6. Exact design, metallurgy and construction of yoke nuts, bonnet bushings, gland followers, handwheels and other vital parts to assure better service for a longer period of time.

Is there any wonder that out in the field, where approval is based on performance under actual operating conditions, industry has put its O.K. on Walworth Steel Valves?

Tough . . . wear resistant . . . dependable, these valves are produced in gate and globe types, in sizes to cover practically every service requirement. They are excellent examples of Walworth leadership . . . leadership that has made the Walworth valves famous throughout the world.

Walworth Catalog 47 gives complete information regarding Steel Valves as well as the full line of Walworth valves and fittings in bronze and iron. Your copy may be obtained upon request. Whenever you need valves — whether steel, bronze or iron — remember Walworth for dependability, economy, and long service life.

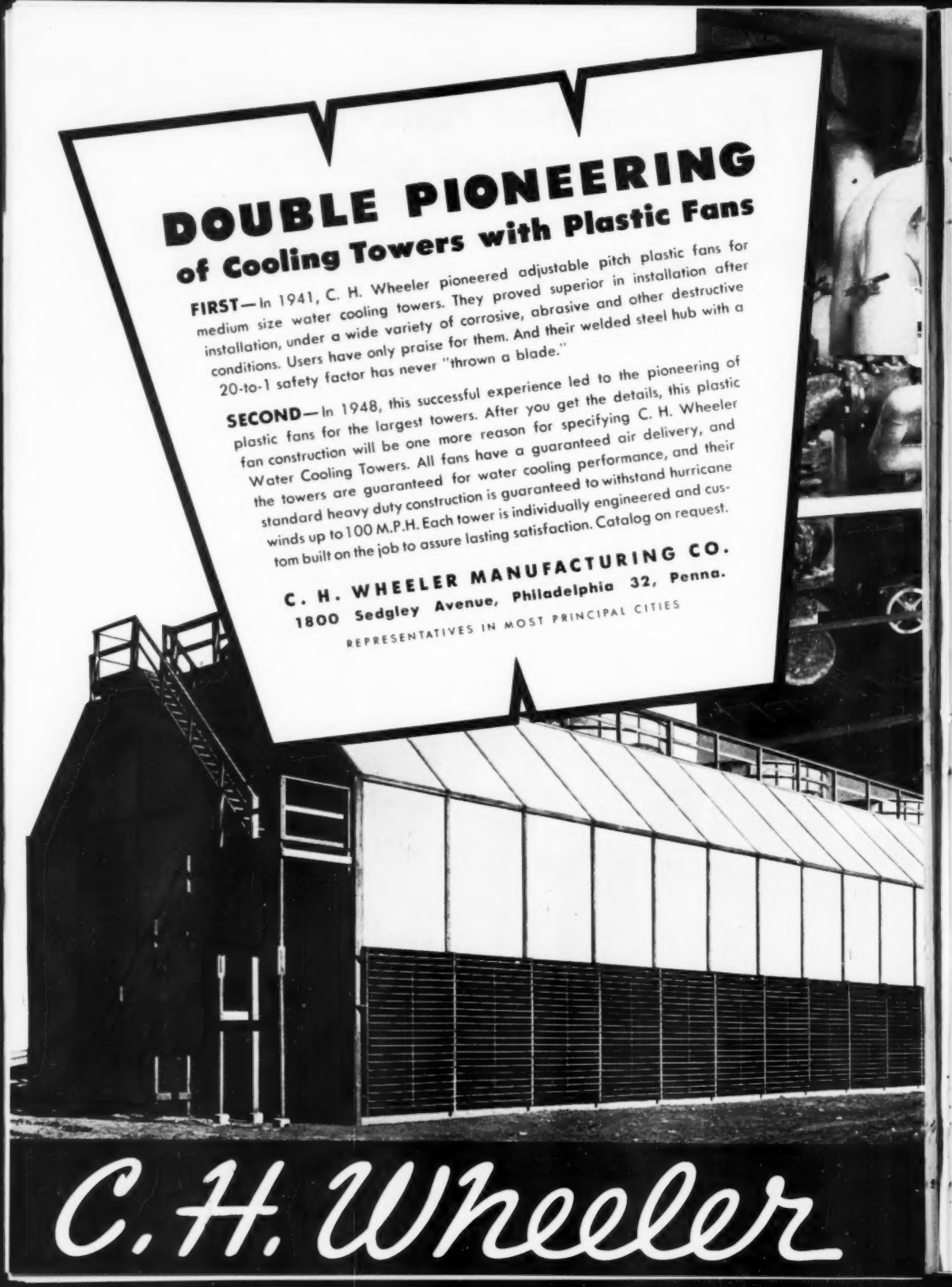
WALWORTH
valves and fittings
60 EAST 42nd ST., NEW YORK 17, N. Y.

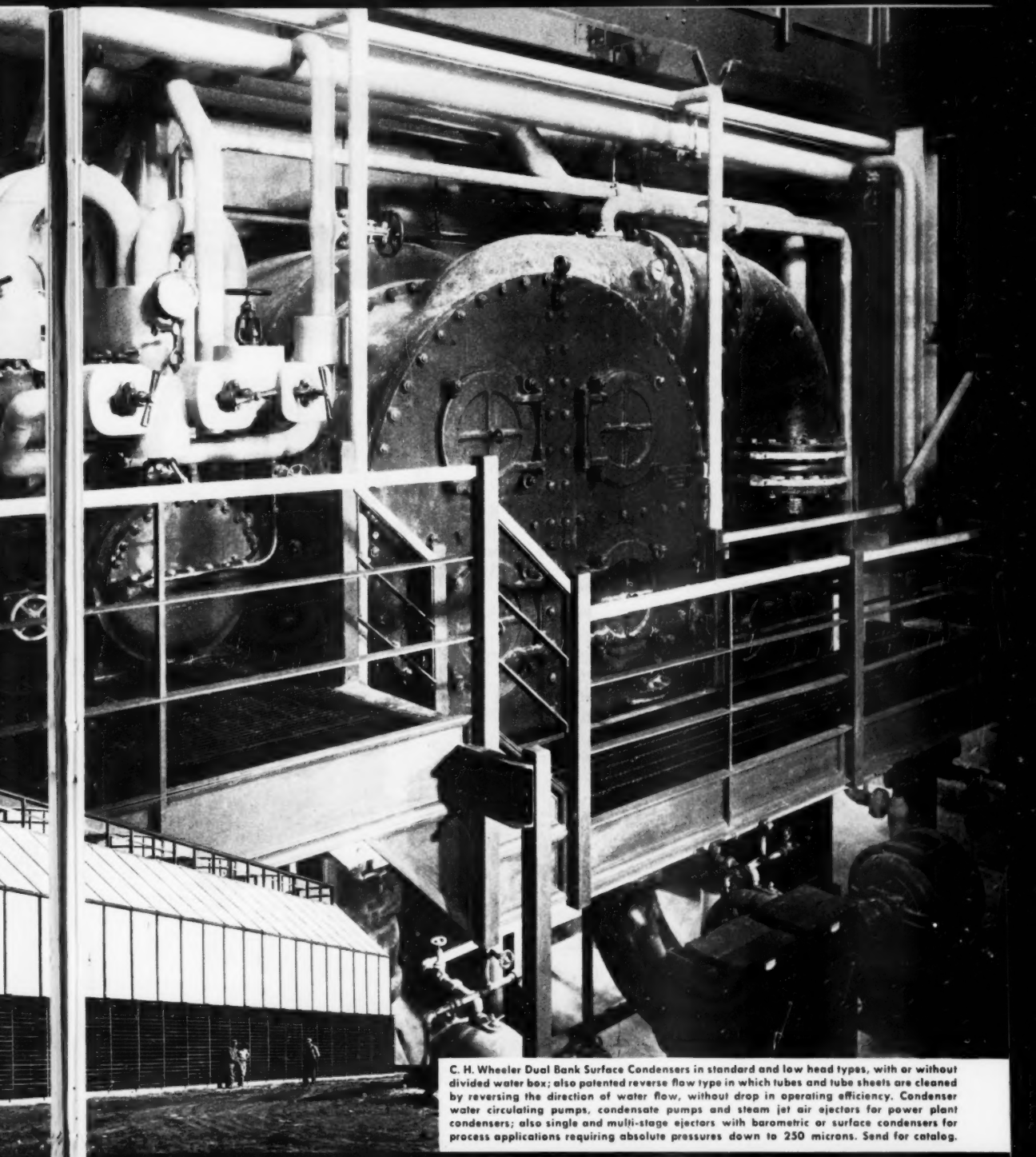

ECONOMIZER
BURNER
BURNER
66"
DIA.
SUPERHEATER
FURNACE
BOILER
FURNACE
CONVECTION
SUPERHEATER
35'-10½"
89'-10½"
37'-0"

For Economical High Pressure and Temperature Operation

Pittsburgh Seamless Boiler Tubes

Boiler operators have long recognized the economy of operation possible with Pittsburgh Steel Seamless carbon and alloy boiler tubes. The sound homogeneous steel, the closely controlled chemistry, the high tensile strength, combined with ductility and size accuracy give you ease of installation and long service. Pittsburgh Boiler Tubes are produced with plain ends or can be supplied swaged, expanded, or upset. Pittsburgh Steel Company, Grant Building, Pittsburgh 30, Pa.


DOUBLE PIONEERING
of Cooling Towers with Plastic Fans
FIRST—In 1941, C. H. Wheeler pioneered adjustable pitch plastic fans for medium size water cooling towers. They proved superior in installation after installation, under a wide variety of corrosive, abrasive and other destructive conditions. Users have only praise for them. And their welded steel hub with a 20-to-1 safety factor has never "thrown a blade."
SECOND—In 1948, this successful experience led to the pioneering of plastic fans for the largest towers. After you get the details, this plastic fan construction will be one more reason for specifying C. H. Wheeler Water Cooling Towers. All fans have a guaranteed air delivery, and the towers are guaranteed for water cooling performance, and their standard heavy duty construction is guaranteed to withstand hurricane winds up to 100 M.P.H. Each tower is individually engineered and custom built on the job to assure lasting satisfaction. Catalog on request.
C. H. WHEELER MANUFACTURING CO.
1800 Sedgley Avenue, Philadelphia 32, Penna.
REPRESENTATIVES IN MOST PRINCIPAL CITIES
C. H. Wheeler



C. H. Wheeler Dual Bank Surface Condensers in standard and low head types, with or without divided water box; also patented reverse flow type in which tubes and tube sheets are cleaned by reversing the direction of water flow, without drop in operating efficiency. Condenser water circulating pumps, condensate pumps and steam jet air ejectors for power plant condensers; also single and multi-stage ejectors with barometric or surface condensers for process applications requiring absolute pressures down to 250 microns. Send for catalog.

STEAM CONDENSERS • WATER COOLING TOWERS
EJECTORS • STEAM JET VACUUM REFRIGERATION

OF PHILADELPHIA

A Triumph IN VALVE ENGINEERING

POWELL

More than ten years ago the Wm. Powell Company built Pressure Seal Valves for a major power plant installation. They were for steam service of 2200 p.s.i. at 950 F. Although this was back in 1938 the valves are still in service—giving a good account of themselves.

The experience thus gained from this initial effort, plus the constant study and research devoted to designing and producing better and better valves, have resulted in the *improved* Powell Pressure Seal Bonnet Valves of today.

A few of the many advantages of Powell Pressure Seal Bonnet Valves:

Body-bonnet joint stays tight under all operating conditions. The greater the internal pressure, the tighter the seal.

Elimination of heavy body-bonnet flanges, bolts and nuts reduces weight, saves space and simplifies insulation problems.

Because of exclusive Powell construction, these valves can be disassembled and assembled much faster than any others—down time is cut to the minimum—inspection, if necessary, is made easy.

Lifting lugs on yoke arms makes these valves much easier to handle and greatly facilitate installation.

Stellite faced seats, discs, stem guides and repack-under-pressure seats assure long, trouble-free valve life.

Flexible "H" type wedge of gate valve prevents sticking when valve is closed hot and allowed to cool before opening, thus reducing required opening torque.

For the complete details of these valves, send for our New Bulletin.

Fig. 11365 W.E.—Class 1500-pound Cast Steel Horizontal Lift Check Valve with welding ends, Pressure Seal Cap, and piston-guided disc. Streamline design permits maximum flow through the valve with minimum pressure drop.

Fig. 11313 W.E.—Class 1500-pound Cast Steel Pressure Seal Bonnet Gate Valve with welding ends, venturied ports and special by-pass. Bevel gear operation.

POWELL

PRESSURE SEAL BONNET VALVES

IN PRESSURE CLASSES FROM 600 TO 2500 POUNDS

Fig. 19084 W.E. — Class 900 - pound Cast Steel Pressure Seal Bonnet Non-return Valve. This improved design reduces to a minimum the pressure drop and turbulence encountered in conventional designs of this type of valve.

Fig. 11323 W.E.—Class 1500-pound Cast Steel Pressure Seal Bonnet Gate Valve with welding ends. Has top-mounted electric motor operator for quick, positive opening and closing by remote control.

Fig. 11331 W.E.—Class 1500-pound small size Cast Steel Pressure Seal Bonnet Globe Valve with welding ends. This design permits practically unobstructed flow through the valve body, thus reducing pressure drop and turbulence to the minimum.

The Wm. Powell Company

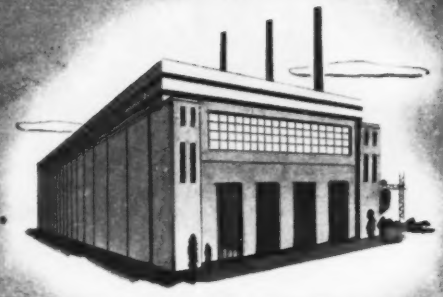
Cincinnati 22, Ohio

DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

VALVES

Whatever the Steam Requirements

ELECTRUNITE



POWER GENERATION

INDUSTRIAL PROCESSING

GENERAL HEATING

TYPICAL POST-WAR INSTALLATIONS IN WHICH ELECTRUNITE BOILER TUBES WERE USED AS ORIGINAL EQUIPMENT

CORNELL UNIVERSITY . . . . Ithaca, New York
SLOANE-BLABON CORPORATION
Trenton, New Jersey
INTERNATIONAL HARVESTER COMPANY
Chicago, Illinois
MID-CONTINENT PETROLEUM CORPORATION
Tulsa, Oklahoma
GENERAL ELECTRIC COMPANY . . . Lynn, Mass.
MANHATTAN SOAP SALES CORPORATION
Bristol, Pennsylvania
SWIFT AND COMPANY . . . Hammond, Indiana
KENNECOTT COPPER CORPORATION
Heyden, Arizona
GILBERT PAPER COMPANY, Menasha, Wisconsin
MORTON SALT COMPANY, Manistee, Michigan
WORCESTER GAS AND LIGHT COMPANY
Framingham, Massachusetts
MISSOURI POWER AND LIGHT COMPANY
Mexico, Missouri
NORTHERN STATES POWER COMPANY
Redwing, Minnesota
CENTRAL ILLINOIS LIGHT COMPANY, Peoria, Ill.
PUBLIC SERVICE COMPANY OF INDIANA
Edwardsport, Indiana
UNION ELECTRIC COMPANY OF MISSOURI
St. Louis, Missouri
CITY OF PROVO, UTAH
OTTER TAIL POWER COMPANY . . . Devils Lake, N. D.; Wahpeton, N. D.; Crookston, Minn.
CHRYSLER CORPORATION . . . . Dayton, Ohio
SCOVILLE MANUFACTURING COMPANY
Waterbury, Connecticut

. . . It Pays to Specify

BOILER TUBES

Here's why: As made by Republic's advanced process of tube manufacture, ELECTRUNITE Boiler Tubes give you valuable, cost-cutting installation advantages . . . plus assurance of dependable, uninterrupted boiler operation.

In this process, clean, flat-rolled steel is cold-formed into tubular shape and electric-resistance welded into strong, sound tubing. Full Normalizing in modern controlled atmosphere furnaces, provides uniformly high ductility throughout every length. Hydrostatic testing affords final proof of dependable top quality, unvarying throughout every shipment.

The result: Modern boiler tubes that bend easily, slide through tube sheets freely, expand smoothly, and bead over to tight, non-leaking joints in a hurry. Actual installation records indicate time savings as high as 30% for ELECTRUNITE Boiler Tubes over ordinary tubes.

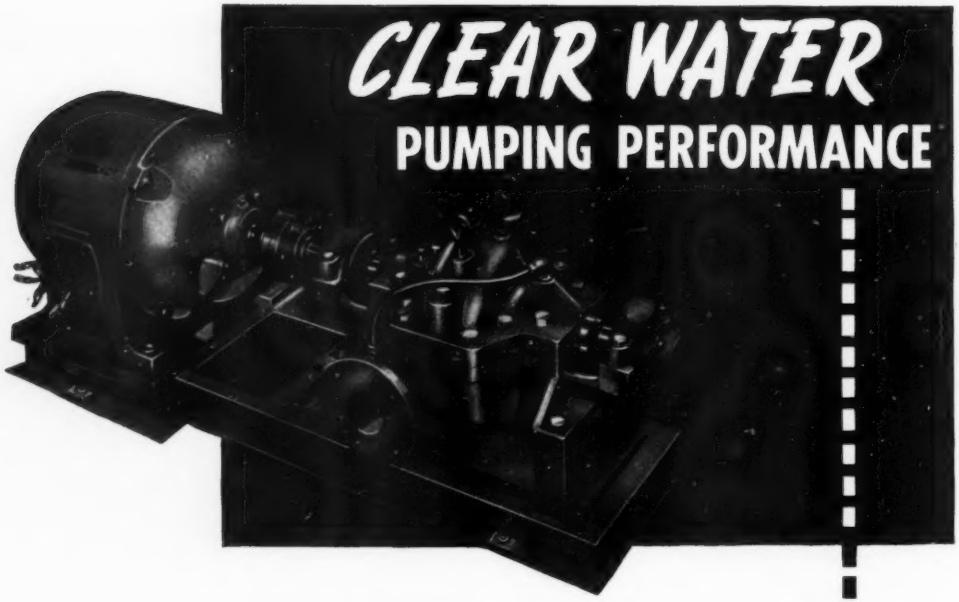
A few of the many post-war installations of ELECTRUNITE Boiler Tubes are shown at the left. For additional information about any of these, or specific data regarding your own boiler installations, write today to:

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
Export Department: Chrysler Building, New York 17, N. Y.

Fast installation is only part of the ELECTRUNITE story. Once installed, these modern scale-free boiler tubes have what it takes to stand up under the most severe operating conditions . . . furnishing long years of maintenance-free service.

Republic
REPUBLIC STEEL
ELECTRUNITE
BOILER, CONDENSER AND HEAT EXCHANGER TUBES

CLEAR WATER PUMPING PERFORMANCE



BACKED BY *Sound Construction!*

"BUFFALO" CLASS "RR" PUMPS are the logical choice for clear water service for many reasons. Their high efficiencies ON THE JOB (as reported by users) mean power savings year after year. Their suitability to handling HIGH PRESSURES (up to 1500 ft. head, in the four-stage models) makes them ideal for a wide range of installations. And their sound construction, shown at right, means maintenance savings and dependability from the word go! It will pay you to look further into this kind of performance—WRITE FOR BULLETIN 960-B shown at left.

SPECIFICATIONS—Two-Stage Class "RR" Pumps

Casing: Semi-steel, divided on horizontal center line, suction and discharge opening cast in lower half. Interior parts can be inspected or removed without breaking pipe connections. Casing mounted on center line supports to equalize expansion around the shaft. Impellers: Bronze, enclosed mixed flow type, hydraulic balance effected by mounting impellers back to back. Casing Wearing Rings: Bronze, labyrinth type having tongue and groove fit. Diaphragm: Solid bronze with renewable bronze liner forming close running clearance over stainless steel abrasion-resisting shaft protecting sleeve. Shaft: High tensile strength steel, bronze covered to protect it from wear thru stuffing boxes with stainless steel sleeves thru diaphragms. Stuffing Box: Packing, Plastic metallic suitable for temperature up to 600°F. Stuffing box pressure reduced by means of a pressure breakdown chamber where working pressure is high enough to require it. Bearings: Deep groove double row angular contact oversize bearings protected in a dust-proof housing. Gland: Bronze, solid type with ample clearance for packing. Water Seals: Bronze. Supplied only for operation with suction lift. Mechanical Flingers: Bronze External labyrinth combination flinger and seal. Coupling: Flexible, all steel. Fittings: Bronze drain and air cocks. Subbase: Cast iron ribbed and provided with oil rim, with drain at pump end. Finish: Painted, filled and rubbed down outside with final finished coat. Bright parts exposed to weather protected by slush compound.

"Buffalo" PUMPS

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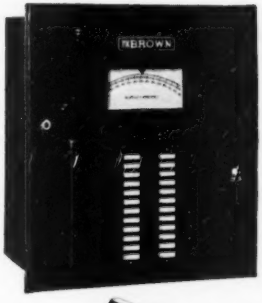

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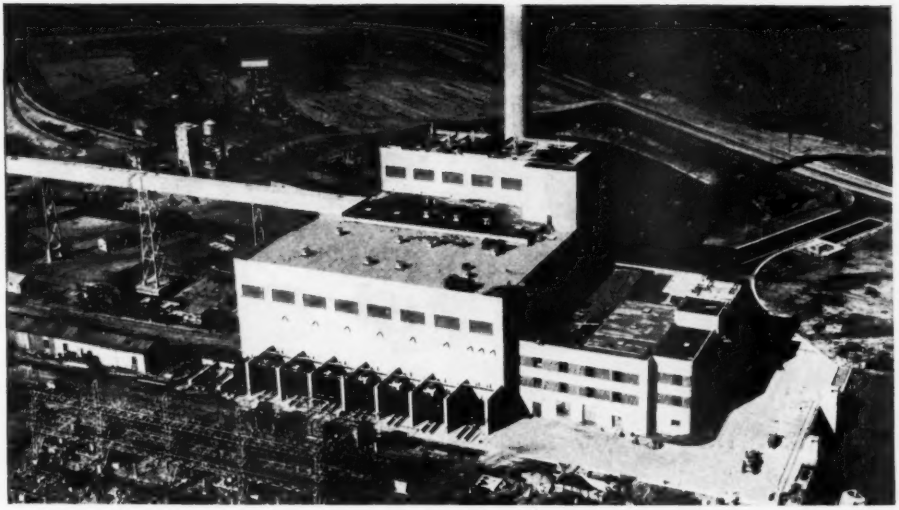

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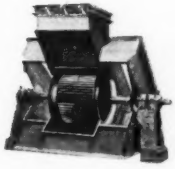

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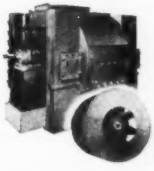

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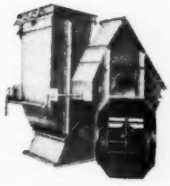

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Find out how standardizing on these smoother-working, more reliable pumps can improve your own pumping operations. For further facts proving *there's more worth in Worthington*, write to *Worthington Pump and Machinery Corporation, Centrifugal Pump Division, Harrison, New Jersey.*

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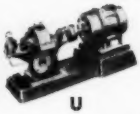
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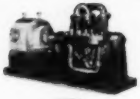
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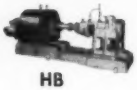
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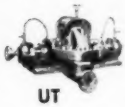
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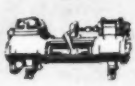

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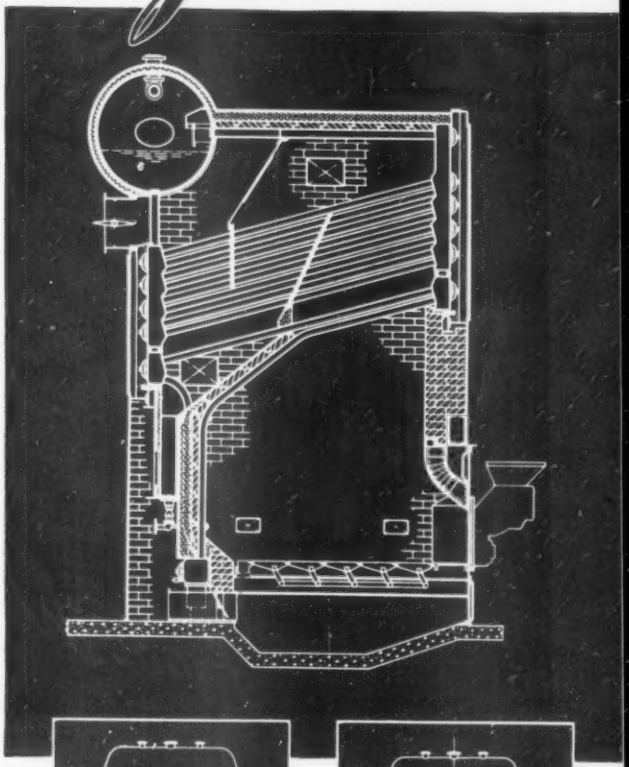

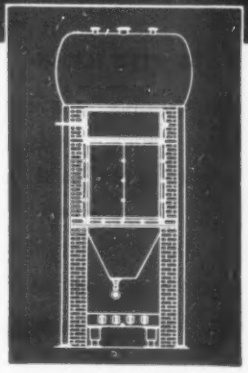

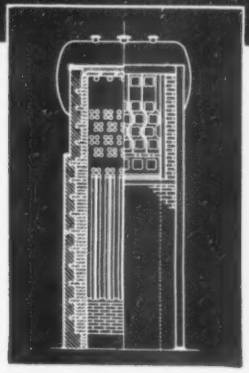

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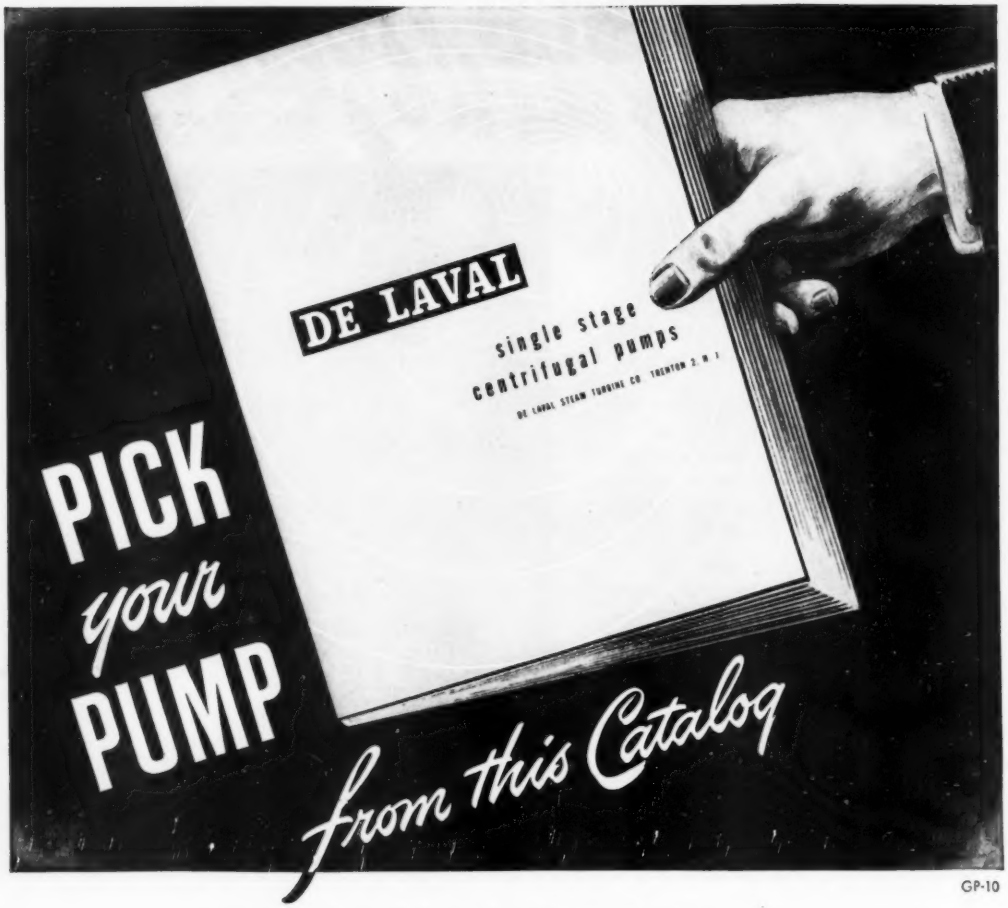

GP-10

COMPLETE WITH RATING TABLES AND DIMENSIONS

The text explains and illustrates features of design that you should look for when buying a pump. The simplified rating tables list pump and motor sizes for delivery and head requirements ranging from 150 gpm and 30′ head to 5000 gpm and 250′ head. The dimension drawings provide all information necessary for preliminary installation layouts. Ask for catalog GP-10.

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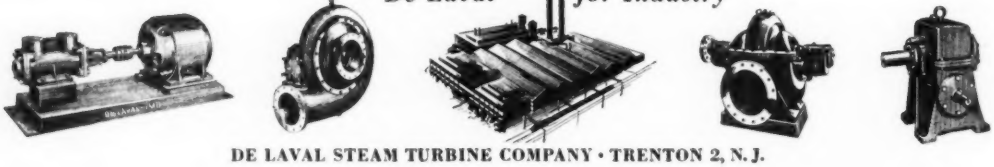

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MAY 1949 • VOL 93 • NO. 5

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Added to Life-Line's outstanding advantages of plate-steel protection, improved windings and more compact size, *pre-lubrication* is one more important reason for starting to convert, today, to Life-Line power. Standard ratings are available from stock—others on short delivery schedules. Ask your Westinghouse representative for price and delivery on your requirements, or write P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21527

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BYERS WROUGHT IRON PIPE

helps to keep this driveway open for traffic *despite* the snow!

The frequent, heavy snows common in the Amsterdam, N.Y. area posed a real problem when the Bigelow-Sanford Carpet Company recently constructed a plant access driveway. This ramp—85-feet long, laid out on a 10% grade, and with a 90° turn—leads from basement to street, and is used by industrial trucks moving materials and finished products between buildings. Any interference with this traffic would delay production and shipping operations, while keeping the drive clear of snow and ice in the usual manner would constitute a major maintenance expense.

The plant engineering staff successfully solved the problem by installing a snow melting system, with a grid of 1¼-inch Byers Wrought Iron pipes connected into 2-inch wrought iron pipe headers. With a water temperature of 130°F, the system is designed to melt 2-inches of snow an hour. Residual water and normal storm drainage are carried away from catch basins located at top and bottom of ramp, through 8-inch wrought iron pipe.

The results obtained have fully justified the judgment of the engineers. In a full winter's operation, with snow depths ranging from 18 to 30-inches, the system worked to perfection. The pavement remained clean and dry without the use of snow shovels or chemicals. Fuel costs are estimated to be low.

In an overwhelming proportion of the successful snow melting systems now installed and operating, designers have used wrought iron pipe for four excellent reasons. The pipe is readily formed and welded. It has a high rate of heat emission. It expands and contracts at practically identical rates with concrete, banning stresses and strains. And its resistance to the corrosive conditions encountered has been conclusively demonstrated in thousands of installations where similar conditions existed.

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POWER

PHILIP W SWAIN, EDITOR • MAY 1949 • ESTABLISHED IN 1882

Will Atom Power Help Russia?

IN HIS RECENT CONTROVERSIAL book, *Fear, War and the Bomb*, the English physicist Blackett argues strongly on the Russian side of the international debate about who should control atomic energy.

Professor Blackett presents plausible "proof" that atomic power could help Russia in her race to speed production. He starts with facts that all must accept —that atom fuel could easily be shipped to any part of Russia—that Russia's total conventional fuel resources per person are less than ours—that the average American uses five times as much electrical energy as the average Russian—that power use and productivity go hand in hand.

From these solid truths it's easy to jump to an unsound conclusion with Professor Blackett—to conclude that Russia should get busy with atom fuel so her people can have more electricity to turn out more goods.

This might make sense if either the delivered cost of fuel or the availability of fuel were a factor limiting Russian power production. Neither one is. The USSR may have less fuel per person than we have, but both nations have enough in the bank for many generations.

Nor is fuel cost an obstacle. Neither country spends as much as one percent of the national income for power fuel. How can cutting this bill to a smaller fraction of one percent allow Russia to leap forward in power production?

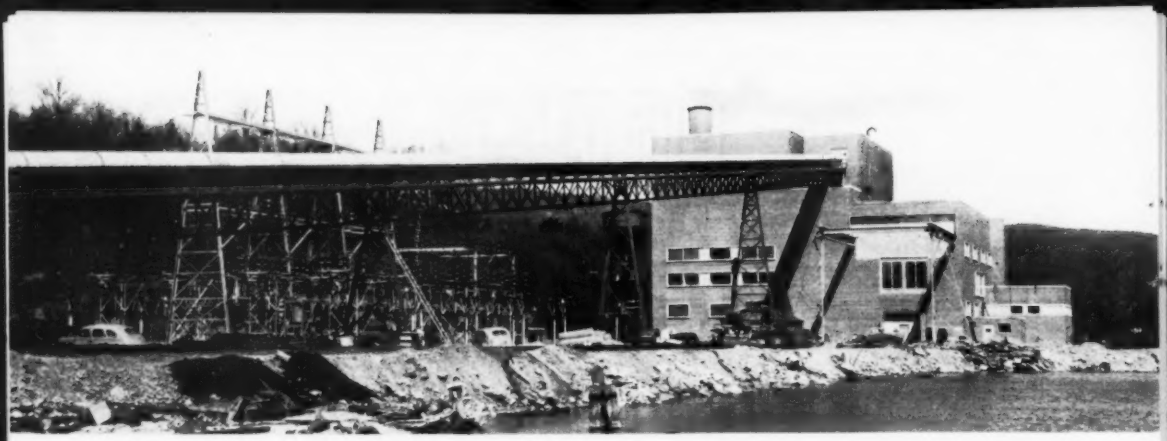
It can't. In Russia, as in any other country with vast underground stores of conventional fuels, producing more power is simply a matter of building more facilities to make power, transmit power and apply power. That means salting away vast amounts of capital (materials and labor) in new power plants, transmission lines, distribution networks, new motors, new machine tools and other productive machines to be driven by the motors.

Suppose Russia sets up a program of atom-power-plant building. The long-run effect will be to save fuel money in yearly driblets over the life of the equipment. But, because it will cost more to build atom power plants, the short-term result will be to hamper power expansion.

If Russia is in a hurry to catch up with American production levels and living standards, this is not the way to go about it. Except in bombs, nuclear fuel is not a short cut to national "power."

Those interested in a more detailed development of this analysis, and of others directed at certain arguments in the Blackett book, should read "Atomic Power and Economic Development," a 6-page article in the March *Bulletin of the Atomic Scientists*, published at 1126 East 59th St, Chicago 37, Ill.

Authors Walter Isard and Vincent Whitney are economist and sociologist, respectively. Their penetrating and realistic study of atomic economics will go far to offset the over-optimistic statements of various natural scientists and social scientists.



20,000-KW STATION has one boiler feeding one turbine. Outdoor switchyard and substation, left; ash hopper, center background. Note crane rails, doors in turbine section of building allowing turbine crane to pick up material outdoors

HUDSON PLANT Designed for Economy

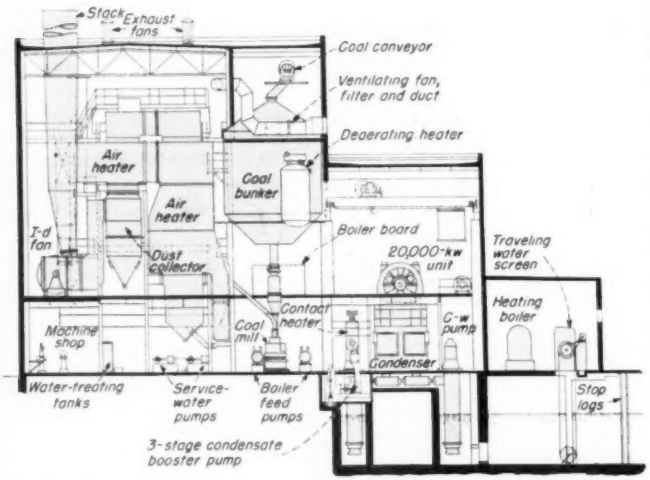
Station features innovations producing energy with maximum economy to offset high prices. Small building volume, few painted surfaces, no separate turbine foundation, standard turbine unit reduce cost

► THE ROCKLAND LIGHT AND POWER CO serves the southernmost section of New York State west of the historic Hudson River and adjacent small areas in New Jersey and Pennsylvania. At the start of the war it was faced with a rapidly growing load. From slightly less than 20,000 kw in 1939, peak load grew to about 41,000 kw in 1948. This was met by an installed capacity, rated at 37,225 kw (about three fourths in hydro), and through interconnections with adjacent utility systems in the region.

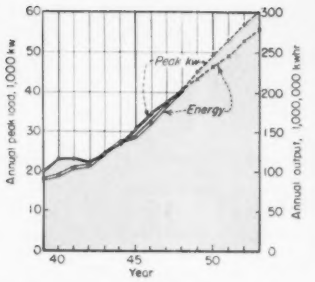
Rockland had been buying about 40% of its energy requirements. Though its service area is largely rural in character almost half the total energy sales are to industrial customers. Rockland County and the other service areas have large summer colonies, which affect load characteristics. Two peaks occur annually, one during August caused by the vacationist influx, and the other in December caused by early darkness. The growing double peak soon left little margin for emergency and scheduled outages.

System Studies. Burns and Roe, Inc. were engaged as engineering consultants to recommend and build additional capacity. Several alternatives were investigated: (1) developing an available hydro site (2) topping the 10,275-kw steam plant, Hillburn, with a 5000-kw unit (3) installing a new high-pressure condensing unit at Hillburn (4) building a new station. The hydro plant did not prove economically feasible for present load conditions. Topping the steam plant, over 30 years old, would salvage the investment in turbine-generators and condensing systems, but would not provide sufficient new capacity. A new condensing unit at the old station would be seriously hampered by lack of cooling water during the summer when the present units must use sprays in the river.

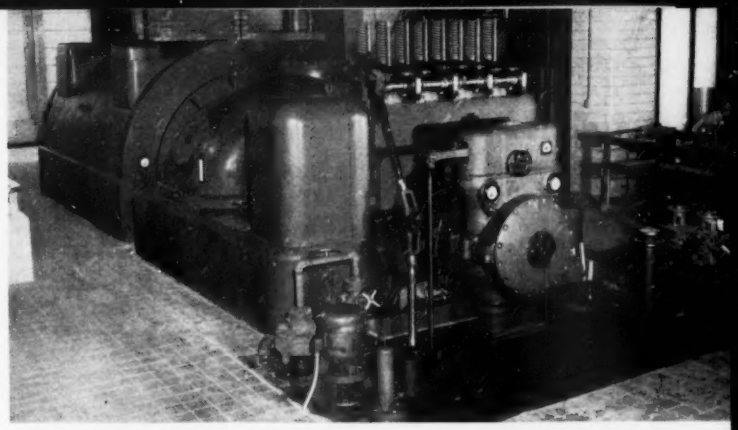
A new steam station with ample cooling-water supply was the answer. Three sites were considered on the west shore of the Hudson River between Haverstraw and Bear Mountain. Tomkins



ALL MOVING EQUIPMENT, except coal conveyor, is on operating-floor and basement levels. There is no division wall between turbine-generator unit and boiler



PEAK LOAD, ENERGY demands have almost doubled in ten years on system



PREFERRED-STANDARD 20,000-KW turbine-generator rests on condenser shell beneath. Single boiler, supplying unit, located to right of column in background

And Reliability With Standard Plans

Cove was selected after surveying the relative merits. Plans were made to erect a station for an ultimate capacity of 120,000 kw—two 20,000-kw and two 40,000-kw units.

First Installation. Unit No. 1, first of the 20,000-kw units, went into operation March 1949. Second 20,000-kw unit, now in the planning stage, is scheduled for operation in August 1951. It will be a duplicate of No. 1. Station is laid out on a unit basis. Each turbine will be supplied from a single boiler with no steam or water interconnections between units.

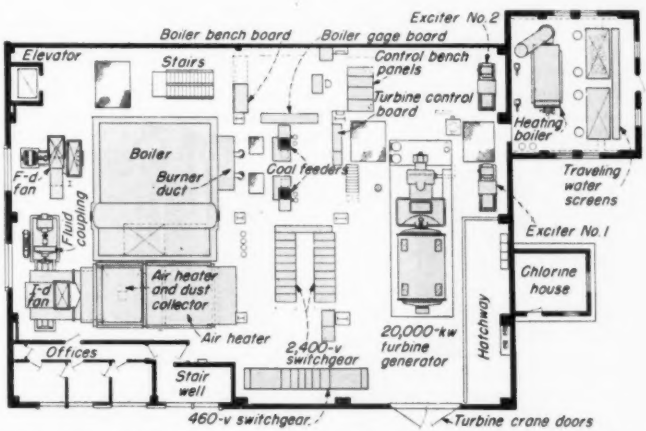
No. 1 is the first of its size of a series of *standard plants* designed by Burns and Roe for operation at elevations up to 1000 ft. Laid out for 20,000-, 30,000-, 40,000-, and 60,000-kw capacities, these plants will be adaptable to any location, within elevation limitations, requiring modification of substructure provisions only. Standard plans can result in appreciable economies by reducing costs of capital investment, operation and maintenance.

Steam Generator. A pulverized-coal-fired integral-furnace boiler, rated at 200,000 lb per hr continuously, supplies steam to the turbine at 850 psig and 900 F. The 2-drum boiler has completely water-cooled walls for the furnace with a full-load heat release of 16,070 Btu per hr per cu ft. An attemperator between superheater sections controls outlet steam temperature.

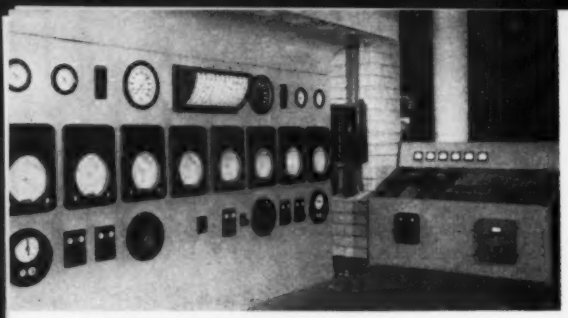
Both an economizer and tubular air heater are provided. Air heater tubes divide into two sections. The first or "cold end" has 10-ft-long tubes, the second 30-ft tubes. If extended low-load operation should cause severe tube corrosion it would be necessary to replace the 10-ft tubes only. The boiler has one motor-driven single-speed vane-controlled forced-draft fan, taking inlet air from under the building ceiling, and one motor-driven induced-draft fan with speed controlled by a hydraulic coupling.

Two ball-race type pulverizers serve the four burners in the boiler furnace. Coal fed to the mills comes from an overhead bunker, holding 290 tons, through two automatic weighing scales. Fuel delivery is via a railroad passing along the western boundary of the plant site. Storage yard at south end of the property holds 35,000 tons. Area can be increased by filling in the river to the bulkhead line. A bulldozer distributes and recovers coal to and from the storage yard. An inclined, steel pan feeder carries coal from the track hopper to a crusher and discharges to inclined belt conveyors to either storage chute or coal bunker. The conveying system has a capacity of 125 tons per hr, ample for ultimate station needs.

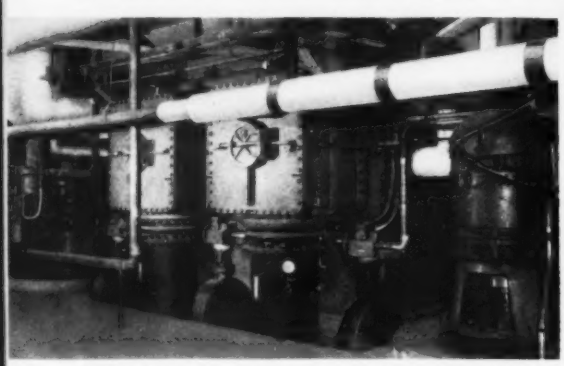
Furnace ash collects in a 14-ton hop-



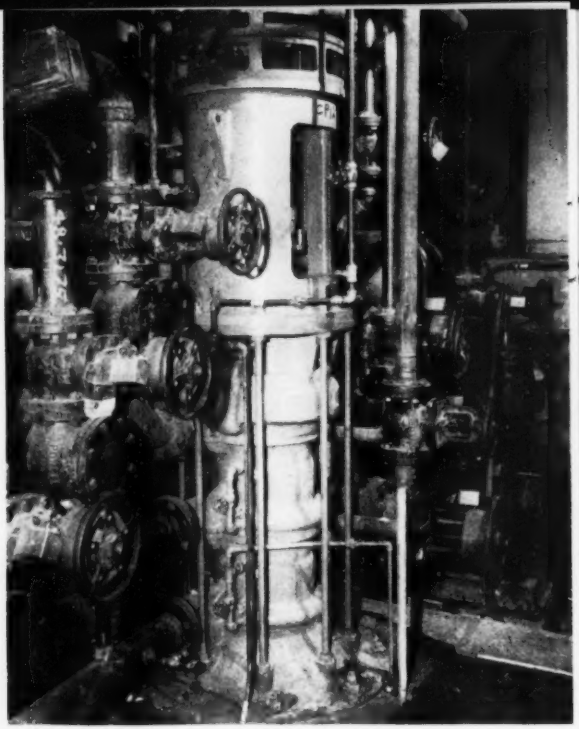
OPERATING FLOOR has central control area for boiler, turbine and switching at upper center. Heating boiler, used during shutdown in screen house, burns oil



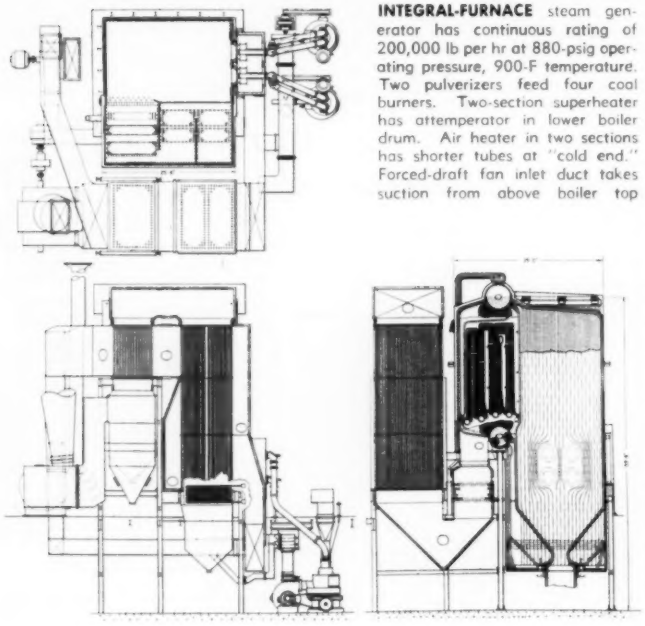
BOILER INSTRUMENT BOARD, left, and bench board, right, comprise part of station control center on operating-floor level



INLET END of main surface condenser has circulating pumps on each side. Condenser shell supports turbine-generator



3-SECTION VERTICAL condensate pump transports water from condenser hotwell through two open feedwater heaters



INTEGRAL-FURNACE steam generator has continuous rating of 200,000 lb per hr at 880-psig operating pressure, 900-F temperature. Two pulverizers feed four coal burners. Two-section superheater has attemperator in lower boiler drum. Air heater in two sections has shorter tubes at "cold end." Forced-draft fan inlet duct takes suction from above boiler top

per below the furnace, from which it sluices and pumps to a 100-ton ash bin at intervals. Bin also collects all flyash from various boiler and duct hoppers through a dust-tight piping system. Bin unloads through chutes into either railroad ash cars or trucks.

Turbine-Generator. Main unit, in accordance with AIEE-ASME preferred standards, has a 20,000-kw rating and 22,000-kw capability. The 18-stage impulse turbine takes steam at 850 psig and 900 F, exhausts it at 1.5 in. Hg abs. Four bleed points on the turbine supply the feedwater heating system. The turbine drives a 23,529-kva hydrogen-cooled generator at 3600 rpm. By raising hydrogen pressure from 0.5 psig to 15 psig, generator capability rises to 27,059 kva.

Perhaps the plant's most outstanding feature is the method of turbine generator support. Instead of the usual foundation carrying the turbine and generator and connecting the turbine exhaust by a flexible connection to the condenser inlet, the condenser shell carries entire weight of the main unit. This arrangement has been used on some shipboard turbine-propulsion plants and on small stationary units, but No. 1

is the first of its size to use the scheme. The condenser shell has a simple rectangular shape. It rests directly on bedrock with intervening grouting. A steel frame or cradle sets directly on top of the condenser, its height being slightly more than half the condenser's height (see POWER, Dec 1948, pp 120-1). The cradle carries the turbine-generator. Space within the cradle accommodates bleed steam, water and oil piping for the turbine.

The 18,650-sq-ft surface condenser has a single pass and divided waterboxes. Two vertical submerged-type circulating pumps supply 12,600 gpm each. Circulating water from the Hudson River enters through a traveling water screen with a capacity of 29,950 gpm. A chlorination plant keeps condenser tubes clean. Only steam-operated auxiliaries in the station are the 2-stage steam-jet air ejector, operating with 400-psig 900-F steam, and the single-stage steam-jet air evacuator, using 850-psig 900-F steam.

Feedwater System. Leaving the condenser hotwell, condensate passes through two open jet-type counter-current heaters in series and then enters a deaerating heater designed for 56 psia pressure. From here two motor-driven, boiler feed pumps pass feedwater through a closed heater, with drain-cooling and desuperheating sections, on its way to the economizer of the steam generator. These heaters are supplied from the four bleed points in the main unit.

Two 3-section condensate pumps of the vertical type handle water from condenser hotwell to the deaerator inlet. First section takes water from the hotwell into first open heater, second section from first heater outlet into second open heater, third section from second heater outlet to the deaerator. Each successive section handles a greater quantity of condensate than the previous one by the amount of bleed steam added in the open heaters.

Raw Water. Entering makeup water first passes through a hydrogen-zeolite treating plant. It then flows through a horizontal U-tube evaporator, 9900-lb-per-hr capacity, equipped with preheater and condenser. Carryover is guaranteed not to exceed a maximum of 1.5 ppm.

Hudson River water is primarily fresh at the plant, but records of nearby points have shown wide erratic variations in salinity, making it unsuitable for makeup. To insure adequate supply a 6-in. water main has been laid for about 1½ miles, tapping the nearest water distributing system.

Electric Equipment. The station-service transformer, tied to the 13-kv generator leads, supplies the station auxiliary-motor drives. Standard 2400-v metalclad and 460-v metal-enclosed switchgear are used throughout the station, each having a single bus. Transmission line acts as both emergency and starting power source, through a 3-phase outdoor transformer and the 2400-v bus. Station-service transformer has noninflammable insulating liquid while the 2400/480-v transformers are air immersed.

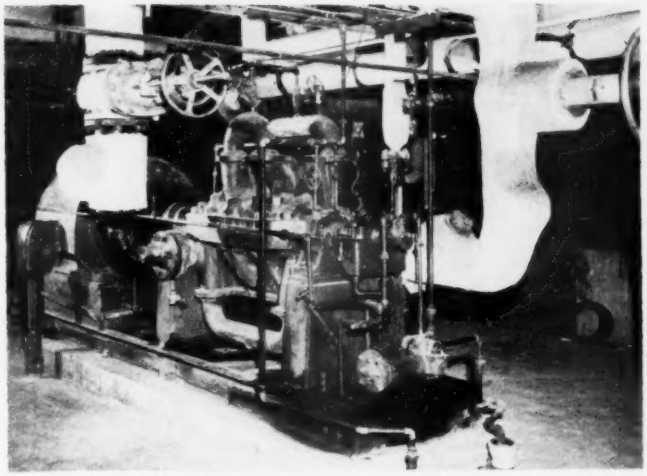
Considering space and arrangement, the station-type busway for the generator leads proved economical.

Power sources and protective equipment for small motors are in and through metal-enclosed motor-control centers. While normally operated from a central control point, these motors also have local pushbuttons. In general, motors of 60 hp and below operate on 460v.

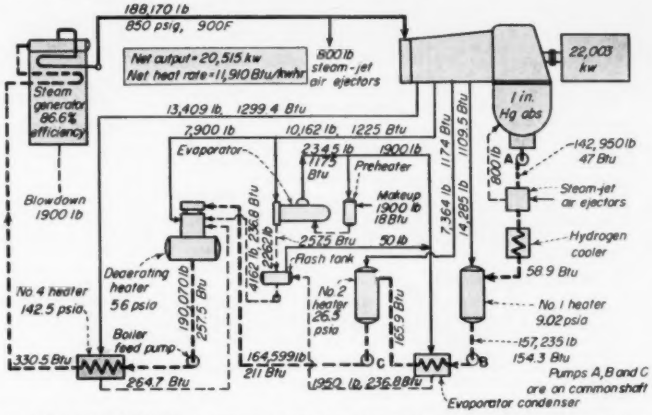
Station layout provides three equal motor-exciter sets for each pair of main generators, one being a spare. The exciters are matched high-inertia type, having sufficient rotating energy to carry excitation without disturbance through such conditions as momentary loss of voltage caused by switching or voltage surges on the line.

The modern outdoor low-level type substation has two buses with an insulation level of 92 kv. Two circuits con-

(*Continued on page 166*)



ONE OF TWO BOILER FEED PUMPS serving the 20,000-kw unit takes its suction from deaerating heater above. Forces feedwater through h-p heater to economizer



UNIT HEAT BALANCE utilizes all four bleed points in turbine, places evaporator in parallel with deaerating heater. First two heaters are the vented, open type

Table of power-plant equipment is given on next page

PRINCIPAL POWER-PLANT EQUIPMENT

No. 1 unit, Hudson Plant, Tomkins Cove, N. Y., Rockland Light and Power Company

STEAM-GENERATING EQUIPMENT:

Boiler, 1 ..... Babcock & Wilcox Co
200,000-lb-per-hr continuous rating, 880-psi operating press, 900-F superheater outlet temp, 17,722-sq-ft heating surface, integral furnace, 16,070-Btu-per-hr-per-cu-ft furnace heat release, 2 drums, 2-section superheater, economizer, tubular air heater, attemperator in lower drum
Pulverizers, 2 ..... Babcock & Wilcox Co
Ball mill, primary air blower on mill motor shaft
Pulverizer motor drives, 2 ..... Allis-Chalmers Manufacturing Co
100-hp 1800-rpm 3-phase 60-cycle 440-v induction motors
Forced-draft fan, 1 ..... B F Sturtevant Div, Westinghouse Elec Corp
Vane control, outlet damper
Forced-draft fan drive, 1 ..... Allis-Chalmers Manufacturing Co
200-hp 1200-rpm 3-phase 60-cycle 440-v direct-connected induction motor
Induced-draft fan, 1 ..... B F Sturtevant Div, Westinghouse Elec Corp
Outlet damper, watercooled bearings
I-d fan hydraulic coupling, 1 ..... American Blower Corp
Induced-draft fan drive, 1 ..... Allis-Chalmers Manufacturing Co
400-hp 900-rpm 3-phase 60-cycle 440-v motor
Soot blowers, automatic steam ..... Diamond Power Specialty Corp
Stack and breeching, 50 ft high ..... Fred W Johnson Co
Automatic combustion control ..... Bailey Meter Co

POWER GENERATING EQUIPMENT:

Turbine-generator, 1 ..... General Electric Co
20,000-kw preferred-standard 18-stage condensing turbine, 850-psi 900-F steam at throttle, 23,529-kva 3-phase 60-cycle 13,800-v 3600-rpm hydrogen-cooled generator
Turbine-supporting condenser, 1 ..... Foster Wheeler Corp
Surface-type 18,650-sq-ft single-pass divided water boxes, one air ejector, 3-element with inter- and after-condensers, 2-stage steam jet operating with 400-psig 900-F steam, one single-stage steam-jet evacuator operating at 850-psig 900-F
Circulating-water pumps, 2 ..... Foster Wheeler Corp
Vertical, submerged type, 12,600 gpm, 14.8 ft head, 495 rpm
Circulating-pump drives, 2 ..... General Electric Co
75-hp 2300-v 3-phase 60-cycle squirrel-cage induction motors
Traveling water screen, 1 ..... Chain Belt Co
29,950 gpm, 10-ft-wide copper baskets
Water screen drive, 1 ..... General Electric Co
2-hp 3-phase 60-cycle 440-v 1150-rpm motor with speed reducer
Chlorination plant ..... Wallace & Tiernan Co

FEEDWATER EQUIPMENT:

Condensate pumps, 2 ..... Foster Wheeler Co
Three-section vertical: 1st-section handles 375 gpm against 143-ft head; 2nd section handles 379 gpm against 92-ft head; 3rd section handles 400 gpm against 148-ft head
Condensate-pump drives, 2 ..... General Electric Co
100-hp 2300-v 60-cycle 1750-rpm vertical squirrel-cage motor
Feedwater pumps, 2 ..... Worthington Pump & Machinery Corp
515 gpm, 2724-ft head, 3570 rpm, 300-F maximum temperature
Feed pump drives, 2 ..... General Electric Co
500-hp 2300-v 3-phase 60-cycle direct-coupled induction motors
No. 1 heater, 1 ..... Foster Wheeler Corp
Jet-type counter-current open heater, 50-psig design press, horizontal U-tube-type 100-sq-ft vent condenser. Raise 150,000-lb-per-hr water from 87 to 175F
No. 2 heater, 1 ..... Foster Wheeler Corp
Jet-type counter-current open heater, 50-psig design press, horizontal U-tube-type 100-sq-ft vent condenser. Raise 165,000-lb-per-hr water from 175 to 237.7F
Deaerating heater, 1 ..... Foster Wheeler Corp
Vertical, 2000-gal storage, raise 176,000-lb-per-hr water from 237.7 to 288.2F, 150-sq-ft U-tube-type vent condenser
No. 4 heater, 1 ..... Foster Wheeler Corp
Horizontal closed type, integral drain cooling and desuperheating zones, U-tube, 1600-sq-ft surface, 4-pass, raise 196,000-lb-per-hr water from 288.2 to 357.8F, 230-psig shell press, 1330-psig tube press
Evaporator plant, 1 ..... The Lummus Co
One evaporator, horizontal U-tubes, bubble tray, 478 eff sq ft, 9900-lb vapor from 10,470 lb-per-hr water. Shell press, 100 psig; tube press, 150 psig; temp 400F. One evaporator condenser, horizontal, 490 eff sq ft, 8415-lb-per-hr condensate. 100-psig shell press, 150-psig tube press. One condensate receiver, horizontal, 9550-lb-per-hr capacity. One flash tank, preheater, two evaporator-drain pumps, blowdown valve and orifice, two Bailey liquid-level controls, one drainer.
Feedwater regulator, one 3-element control sys ..... Bailey Meter Co
Water-treating plant, 1 hydrogen zeolite ..... Permutit Co

PIPING:

Piping contractor ..... Harry Hoyle Co
Piping fabricator ..... Grinnell Co
High- and low-pressure valves ..... William Powell Co
Iron body valves ..... Ludlow Valve Co, Chapman Valve Co
Altitude valves ..... Golden Anderson Valve Specialty Corp
Bleeder check valves ..... Atwood & Morrill Co
Blowdown and power-control valves ..... Manning, Maxwell & Moore, Inc
Nonreturn valves ..... Crane Co, Edward Valves, Inc
Miscellaneous piping equipment ..... Andale Manufacturing Co, V D Anderson Co, Yarnall-Waring Co, Henry Vogt Co, Clark Manufacturing Co, Foster Engineering Co
Insulation ..... R A Keasby Co

COAL AND ASH-HANDLING EQUIPMENT:

Coal-handling equipment ..... Stephens-Adamson Manufacturing Co
Track hopper, gate, grizzlies. Apron feeder, 125-tph capacity, one crusher with automatic apron. One crusher bypass with flop gate. One belt conveyor on 132-ft centers, 33-ft-lift, 125 tph at 250 fpm. Driven by 10-hp 440-v totally enclosed motor. One belt conveyor on 467-ft centers, 49-ft lift, 125 tph at 250 fpm, driven by 15-hp 440-v open motor
Coal bunker, 1, cap 290 t ..... Poirier & McLane Corp, Central Tank Corp
Coal scales, 2 ..... Richardson Scale Co
Totally enclosed, dustproof, all-electric, automatic weighing hopper scale. Hopper capacity 200 lb or 15 tph. Driven by ½-hp totally enclosed motor. Dripproof and siftproof coal valves, no-flow alarm switches
Ash- and dust-handling system ..... Allen Sherman Hoff Co
One 14-ton ash hopper, one sluicing system with transport nozzles, one ash-transfer sump, one hydroseal ash pump, one hydrovac dust-handling system with wind-swept valves, 20 tph capacity, one hydrobin, 100-ton capacity with railroad or truck unloading

ELECTRICAL EQUIPMENT:

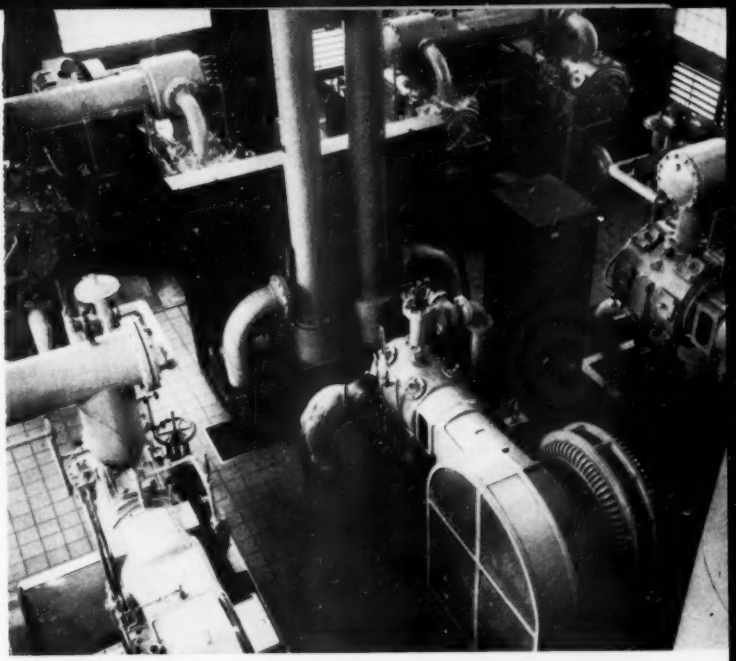
Battery-charging motor-generator set ..... Electric Products Co
15-hp 440-v 1200-rpm motor, driving 7.5-kw 140-v generator
Bus ducts and conductors ..... General Electric Co
Electrical contractor ..... Watson & Flagg, Inc.
Main and instrument transformers ..... General Electric Co
Switchgear ..... Allis-Chalmers Manufacturing Co
2400-v 460-v switchgear and accessories, station-service transformer, generator excitation-control unit, station-service control unit.
Exciter set, 2, capacity 150 hp ..... General Electric Co
Main-generator voltage regulator ..... General Electric Co
Main control switchboard ..... Westinghouse Electric Corp
Unloading stations ..... Westinghouse Electric Corp
Circuit breakers ..... General Electric Co
Outdoor switchyard ..... General Electric Co

MISCELLANEOUS EQUIPMENT:

Lubricating-oil purification ..... DeLaval Separator Co
Ventilating fans, 4 ..... Joy Manufacturing Co
18,000 cfm against 15 in. water, 2-stage, 5-hp motor drive
Exhaust fans, 2 ..... Joy Manufacturing Co
10,000 cfm against 2-in. water, 5-hp motor drive
Turbine-room crane, 25-ton ..... Shepard Niles Crane Co
Auxiliary heating boiler, 1 ..... Kewanee Boiler Corp
Oil-fired firetube 15-psig boiler
Heating-boiler oil burner ..... Gilbert & Barker
Tanks ..... Turl Engineering Co, Harold Lasker Co, Inc
Service-water pumps, 3 ..... DeLaval Steam Turbine Co
Single-stage centrifugal, 1100-gpm against 248-ft head, 100-hp 2300-v squirrel-cage induction-motor drive.
Metering equipment ..... Bailey Meter Co
Boiler panel and bench board, control-air compressor, pressure and temperature recorders, water-level recorders and controllers, steamflow-airflow meters, smoke recorder, master selector valve, air heater and economizer air-and-gas-temperature recorders, coal air temperature indicator controller, draft gage, salinity indicator, damper control drives, i-d fan hydraulic coupling control, furnace and forced-draft controls
Pressure gages ..... Manning, Maxwell & Moore, Inc
Thermometers ..... Manning, Maxwell & Moore, Inc
Turbine-generator gage board ..... General Electric Co
Air filters ..... Farr Co
Air preheaters ..... Trane Co
Turbine-room crane door ..... Byrnes Doors, Inc
Service-air compressor ..... Joy Manufacturing Co
Laboratory equipment ..... Eimer and Amend, Fisher Scientific Co
Building superstructure ..... Deakman-Wells Co, Inc
Building substructure ..... Poirier & McLane Corp
Structural steel ..... Belmont Iron Works
Consulting engineers ..... Burns and Roe, Inc

Correct selection of steam- and motor-driven air compressors produces a heat balance that permits using all exhaust for heating, process. A full complement of meters and comprehensive records are a guide to top operation

By FELIX M GIORDANO
Paterson, N. J.



1 This plant has two 980-cfm steam-engine-driven compressors, two 200-hp 930-cfm synchronous-motor-driven units, and one 150-cfm synchronous-motor compressor

Good Operation Pays Dividends In This Compressed-Air Plant

► NEXT TO STEAM PRODUCTION for power, heating and process, the most important function of the Curtiss-Wright Corp's power house, at Caldwell, N. J., is to supply compressed air for process and control in manufacturing operations. Four large 2-stage compressors and a small single-stage unit deliver air at 100 psig to a large receiver, from which it is piped to different parts of the plant.

Compressor Capacity. Two 980-cfm compressors are steam-engine driven, two 930-cfm units are driven by 200-hp synchronous motors, and a synchronous motor powers a 150-cfm unit. The latter is used during weekends and on holidays when the manufacturing plant is shut down.

The fact that two of the large compressors are steam- and two motor-driven permits operating so all exhaust steam goes to the heating and process systems at all times. Generally one motor- and two steam-driven compressors are used in winter when building-heating load is heavy. In summer when this load is light one steam- and two motor-driven units are usually operated.

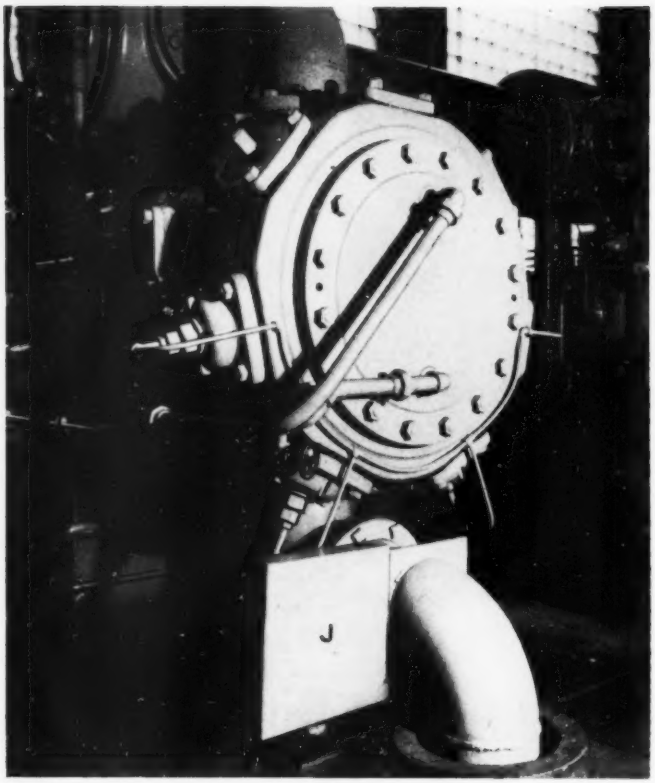
The engine-driven compressors have both load and speed flyball governors, operating through hydraulic relays to change the cutoff in connection with a piston valve. These governors regulate compressor speed to maintain practically constant air and exhaust-steam pressure. Steam is admitted to the engines at 185 psig saturated, and exhausted at 35 psig for feedwater and building heating, and for process.

Low-pressure steam demand is always greater than the engine exhaust, make-up steam being supplied from the 185-psi line through a reducing valve. The makeup eliminates moisture in the low-pressure steam and superheats it slightly.

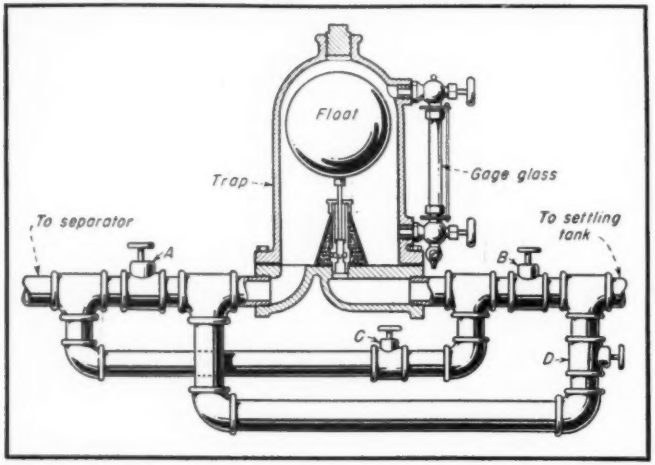
Cleaning Engine Exhaust. To avoid fouling the boilers and processing units with engine-lubricating oils, engine exhaust is cleaned by separators and traps, in series. The traps are especially designed to handle both oil and condensate. Trap discharge goes to gravity-oil separator where the oil is tapped off as needed.

This arrangement, coupled with periodic blowing down of the feedwater heater, keeps all traces of oil from the boilers. Minute traces that may find their way to processing units are not objectionable, as the processes are such as to prevent accumulation of impurities.

Even though the traps are designed to handle both oil and condensate, they cannot be expected to take care of carbon and gummy deposits from the steam engines. It was, therefore, necessary to open and clean the traps at regular intervals. One of the operators, probably tired of this recurring dirty



2 When oil vapors could not be prevented from escaping from the air-intake lines special jackets, as in J, were built that are installed on the slide dampers



3 To eliminate the unpleasant job of opening the air traps and cleaning the carbon and gummy deposits from them, they were piped in order to blow them clean

job, developed a way of cleaning the traps without removing them from the line, by backwashing with steam. This involved only the installation of some simple piping and a couple of valves, as in Fig. 3.

During normal operation valves *A* and *B* are open, whereas *C* and *D* are closed. When we clean a trap by backwashing we close valve *B*. This stops trap discharge and it fills with condensate. When the trap is nearly full we close valve *A* and open *C*, which admits condensate from the separator in counterflow to the trap. Valve *D* is now cracked open to allow some condensate to escape from the trap. This flow is replaced by condensate and steam from the separator, which can be checked by a clacking noise of the trap's valve moving off and onto its seat.

This operation is continued for about two minutes. Then valve *D* is opened wide and everything blows out from inside the trap. After this backwashing, valves *A* and *B* are opened, and *C* and *D* closed to put the trap back in service. Effectiveness of backwashing is apparent by the condensate's clear color in the gage glass. As a result, the trap is now no longer out of service for more than a few minutes at a time. It has not been taken apart for cleaning since backwashing was installed.

MOTOR-DRIVEN COMPRESSORS

The synchronous-motor-driven compressors operating at constant speed are equipped with 4-stage unloading governors. These permit operation at 0, 25, 50, 75 or 100% of capacity.

Intercoolers and Aftercoolers. Each 2-stage compressor has a counterflow intercooler with automatic water-flow control operating on exhaust-water temperature. Temperature recorders are on each compressor and on the aftercooler. The latter is a vertical shell-and-tube type equipped with traps to remove condensed vapor from the compressed air. Cooling water from the aftercooler is used for feedwater makeup, thus making a considerable saving by reclaiming water, chemical treatment and heat.

Plant Cleanliness. Cleanliness is important in the efficient operation of every power plant and there is no place where the engineers are more conscious of this than at the Curtiss-Wright plant. Here cleanliness is achieved by seeking out the causes of dirt, and eliminating them rather than by continuous wiping. This elimination of dirt at its sources has called for alertness and ingenuity. If the cause of the dirt could not be removed, special collectors were designed, which are emptied from time to time.

POWER HOUSE LOG

WATCH ENGINEER	FIREMAN	REPAIR MAN	HELPER	HIGHEST OUTSIDE TEMP.	LOWEST OUTSIDE TEMP.	SHIFT	DATE
				°F A.M. P.M.	°F A.M. P.M.	TO	

METER READINGS

	BOILER No. 1	BOILER No. 2	BOILER No. 3	Steam Comp. No. 1	Steam Comp. No. 2	Elec. Comp. No. 4	Elec. Comp. No. 5	Air—Bldg. No. 1	Air—Bldg. No. 2	Steam—Bldg. No. 1	Steam—Bldg. No. 2
E											
S											
N											
F	359	359	359	1039	1039	100	30	2400	600	4000	170/250
C	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	K.W.H.	K.W.H.	Cu. Ft.	Cu. Ft.	Lbs.	Lbs.

BOILER	BOILER WATER ANALYSES—P.P.M. Alkalinity	Buromin	Chlorides	Santosite	VALVES BLOWN Manual B.D. Valves	Cont. B.D. Setting
No. 1						
No. 2						
No. 3						

BOILER CHEMICALS		FUEL OIL TANK READINGS—8:00 A.M.		PUMP OPERATING	OIL	WATER	COAL SCALE	CITY WATER
BUROMIN	Lbs.						E	
CAUSTIC	Lbs.	No. 1		No. 1			S	
SANTOSITE	Lbs.	No. 2		No. 2			U	
HARCO	Lbs.	No. 3		No. 3			F 200	600
							Lbs.	Lbs.

MASTER	OIL METER—SUPPLY	OIL METER—RETURN	No. 1	OIL METER—SUPPLY	OIL METER—RETURN	No. 2	OIL METER—SUPPLY	OIL METER—RETURN	Oil Cons. in Gal. at 60°
E									
S									Evap. Lbs. St. Per Gal. Oil
U									Evap. Lbs. St. Per Lb. Coal
									Coal Rec. / Oil Rec.

COMPRESSOR	HOURS IN SERVICE	LUB.	OPERATION	TEMP. H.P.C.	TIME	LUB.	OPERATION	TEMP. H.P.C.	TIME	LUB.	OPERATION	TEMP. H.P.C.	TIME	LUB.	OPERATION	TEMP. H.P.C.	TIME
No. 1—Steam				°F				°F				°F				°F	
No. 2—Steam				°F				°F				°F				°F	
No. 4—Elec.				°F				°F				°F				°F	
No. 5—Elec.				°F				°F				°F				°F	
AFTERCOOLER TEMP.		WATER OUT		AIR OUT		WATER OUT		AIR OUT		WATER OUT		AIR OUT		WATER OUT		AIR OUT	

Weather:	OUTSIDE TEMP.	1 AM	3 AM	5 AM	7 AM	9 AM	11 AM	1 PM	3 PM	5 PM	7 PM	9 PM	11 PM
Hot Well Temp.		1 AM °F	3 AM °F	5 AM °F	7 AM °F	9 AM °F	11 AM °F	1 PM °F	3 PM °F	5 PM °F	7 PM °F	9 PM °F	11 PM °F

Oil Used	Cyl.	No. 1 Comp.	No. 2 Comp.	MOTOR OIL	No. 1 Comp.	No. 2 Comp.	No. 3 Comp.	No. 4 Comp.	No. 5 Comp.

REMARKS:

Watch Engineer: _____

Chief Engineer: _____

4 A log is kept by each shift on which is recorded steam, air and electric-power consumption and data from other meters. The chief engineer uses this log to guide supervision of the plant and to make his monthly report to the management

An example is the prevention of an oil film forming over everything near the slides in the compressor-intake pipes. It was found that oil vapors could not be prevented so a special jacket was designed and installed on the slides, Fig. 2. The oil particles now impinge on the inner walls of this jacket *J* and collect in a trough at the bottom. These and a number of other devices have succeeded in eliminating dirt as a chronic factor in this power house.

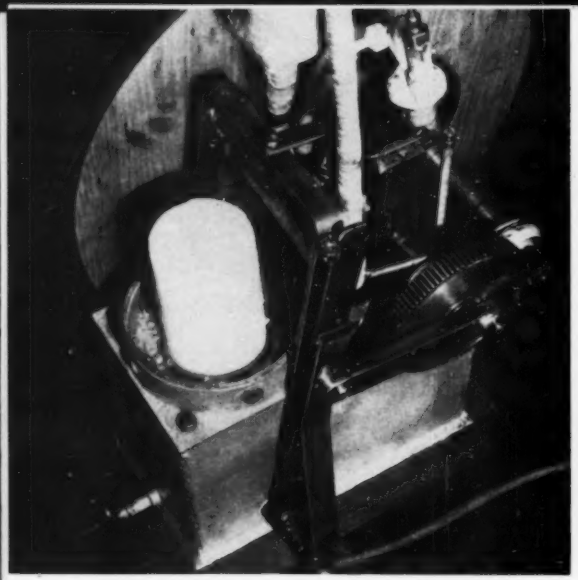
As a result the pleasing appearance of the plant makes for a cheerful working atmosphere. Perhaps even more important is the fact that dirt is not free to settle on delicate control mechanisms, in bearings and on pieces of equipment, where it can seriously disrupt operating routine. This dirt-elimination policy pays dividends in increased life expectancy of equipment, reduction in maintenance and in improved working conditions.

Metering System. The plant is well metered so a close check on operation is maintained. Steam from each boiler is metered as well as the steam to each of the engine-driven compressors. Exhaust steam to each building is metered as is the air to these buildings and the power to each motor-driven compressor. All other important quantities used in the plant are metered or weighed, so a comprehensive record can be maintained at all times.

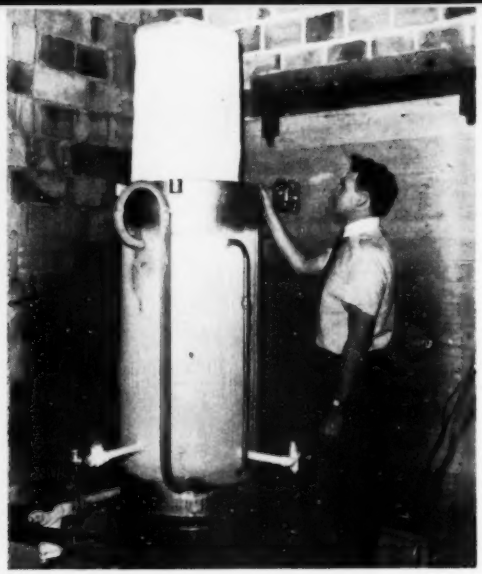
Each shift keeps a log, Fig. 4. On it are recorded all readings of flowmeters, temperature recorders, thermometers and other meters taken at regular intervals. Also, a record is made of special work done and happenings, such as a power failure, or the stopping of a machine and putting another on the line, with the time of the occurrence.

Final readings of meters for each shift are, of course, the starting readings for the next shift. Each engineer, when coming on shift, takes these readings and calculates the steam, air and power consumption used or delivered by the previous shift. Factors are provided where needed for computation. For example, under boiler No. 1, *E* indicates the steam reading at the end of a shift; *S* is the reading at the start of the shift; *N* is the net steam used, the difference between *E* and *S*. *F* is the meter factor, in this case 359, by which *C*, the steam used, is calculated. *U* as found under other headings means "used."

Chief Engineer A N Musgrave uses the logs for his own information and for power-house reports to the management—monthly and at other times. In addition, charts are maintained to give a visual indication of trends in the production and cost of power-house products and materials. These charts are for total as well as unit costs. By this means the chief engineer, and through him, the management know at all times not only the operating costs but also the causes for fluctuations that take place. Some of these are of a seasonal nature; others depend on the cost of labor, materials, supplies and services.



1 First model produced a round core 3⅝ in. in diameter and proved it possible to freeze thin layers into thick blocks



2 First commercial-size unit extrudes 80 lb of ice an hour, or about one ton in 24 hr, in a 12x15-in. vertical column

Machine Makes Cake Ice by Extruding

Direct-expansion freezing cylinders, developed by John R Watt, University of Texas, extrude hard white ice* by freezing it in thin layers between the leaving ice and enclosing surfaces

► In 1943, EXPERIMENTS to develop a continuous process for making cake ice proved it was practicable to (1) shear ice intact from a submerged freezing surface (2) freeze water between the two surfaces to form a new ice layer bonded to the old, and (3) repeat the process layer by layer to generate solid blocks of a desired size and shape.

Original Unit. Accordingly, the small machine in Fig. 1 was constructed. Basically, it was a tank of water in which a double-walled, tapered freezing cylinder was mounted big end up, and cooled by direct expansion. A perforated ram, driven by an eccentric and rocker arm, reciprocated vertically in the lower or small end of the cylinder. Later, the eccentric was replaced by cams to give the ram a dwell, or freezing period, between strokes.

When run rapidly, the machine formed nesting, circular ice shells about 1/32 in. thick, like nested paper cups. Run slowly, it made a broken hollow column of white ice with ¾-in. walls.

A second freezing cylinder, of 3⅝ in. diameter and different taper, was made and polished to reduce ice adhesion. It soon proved that a 4-factor compromise was necessary: Temperature, freezing time, lift of ram, and cylinder taper must all be reconciled. After a reservoir of chilled water was installed at the top, the new cylinder produced solid ice cakes in early 1946.

Referring to Fig. 1, operation is as follows: With the ram in low position and the machine filled with water, an ice core is frozen in the tapered cylinder. When core is solid the ram mechanism is started, which periodically shears the ice from the cell walls and lifts it intact about ⅛ in. Since both core and cylinder are tapered, lifting the ice opens a thin annular void all the way around it. Suction and capillary action fill this void with water from the reservoir, while the ram returns to its original down position. Water film is about 1/64 in. thick and freezes in 10 to 15 sec, depending on temperature maintained in the evaporator.

Each successive new layer of ice freezes integrally to the one before. Each cycle, therefore, adds new ice below and around the core, forming a column that extrudes, step by step, upward out of the cylinder. About four to five cycles per minute gave optimum output on test.

Freezing Rate. With –10 F suction temperature, ice-freezing rate is about 27 lb per sq ft of freezing surface per hr. Heat transfer on test was about 72 Btu per sq ft per hr per deg F temperature difference, or about 70 times the estimated over-all heat transfer in a can-ice plant. The machine has a pronged cutter to sever the ice column automatically into 5-in. lengths, Fig. 1.

Next cylinder was designed to extrude 4½x5-in. bricks of frozen orange juice for consumer packages. This cylinder proved that rectangular extrusion was possible. Third cylinder extruded round cakes to fit 1-gal cartons. Fig. 3 shows the latter two units on the test stand, the 6⅞-in. diameter ice column showing clearly. The operator is examining a sample brick from the 4½x5-in. column. The juice experiments, conducted in the Rio Grande Valley, were quickly

* Abstract of a paper delivered at the ASME 1948 annual meeting in New York, N. Y.

3 Experiments conducted to study the freezing of fruit juices were soon abandoned. Although each layer of juice froze quickly the mass was too soft for the ram load

TEST RESULTS ON ONE-TON ICE MACHINE

Suction temperature, F	5
Head pressure, psig	106
Compressor power input per hr, kw	2.5
Freezing surface, sq ft	8.65
Insulation	None
Inlet-water temperature, F	69
Precooled-water temperature, F	40
Ice-cake temperature (est), F	28
Ice-cake cross section, in.	12x15
Ram cycle, sec	55
Ice lift per cycle, in.	0.23
Ice lift per hr, in.	13.8
Ice output per hr, cu ft	1.44
Hydraulic-unit total input, kw	0.75
Hydraulic-unit idle input, kw	0.60
Timing-motor input (est), kw	0.05
Total net power input per hr, kw	2.7
Total net ice output per hr, lb	80

SUMMARY*

Ice in 24 hr, total, lb	1920
Kwhr per ton of ice	67.5
Ice, lb per sq ft of freezing surface per hr	9.25
Heat-transfer rate (Btu per sq ft per hr per F)	51.4

*Tests made with machine uninsulated.

A Continuous Core

abandoned. Although each increment of juice congealed with adequate speed, the pulp and sugar content kept the mass somewhat soft for the compression loads of the ram.

In 1948, the one-ton ice-making machine in Fig. 2, was designed as a pilot commercial plant. Built by Modern Supply Co of Austin, Texas, it uses a floor area of 3x3 ft.

This unit has a tapered rectangular inner cylinder that extrudes an ice column 12x15 in. in cross-section. Inner cylinder is welded from unpolished flat panels of ¼-in. boiler plate, stiffened longitudinally by ribs in the refrigerant space, and welded permanently into the refrigerant jacket of ¼-in. rolled steel. It provides a net freezing surface of 8.65 sq ft.

Water Circulation. Below the jacket is a precooling chamber, refrigerated by both conduction and suction gas from the evaporator. Suction line loops upward from the jacket top, then turns down and enters the precooling chamber. It emerges at the lower left, behind the thermostatic expansion valve, which controls both jacket and precooler. Water enters the machine through a float valve at the upper rear, and is precooled to about 40 F before reaching the reservoir in the top extension of the jacket.

The ram, which is square, is the only moving part. It is operated by a hydraulic cylinder below the precooler; piston rod and ram retreat into the precooling space between strokes. The hydraulic cylinder is controlled by a Vickers "Power-Pack," a hydraulic-power unit containing pump, oil reservoir, filter, relief valve and 4-way slide valve in one casting.

Power-Unit Control. A 1/20-hp timing motor and cam actuate the slide valve and through it the ram of the freezing cylinder. Both timing and stroke are adjustable. Power unit runs idle between ram movements. Since it has two additional slide valves, it should be able to drive three freezing cylinders economically. There are no other auxiliaries.

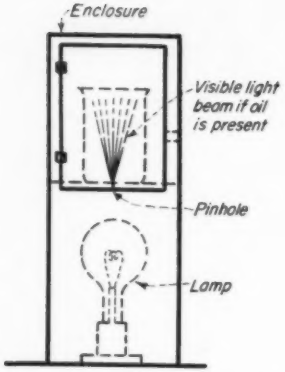
Refrigeration is supplied by a 3-hp Brunner air-cooled Freon compressor charged with methyl chloride, and a suction-line heat exchanger.

Several automatic ice cutoff arrangements seem applicable, and no difficulty is anticipated in severing lengths of 25, 50, 75 or 100 lb for discharge by chute. Similarly, no special difficulties are seen in the construction of multi-cylinder ice plants. Welded into one full-flooded casing and controlled by one expansion valve, it seems likely that a 6-cylinder 11-ton machine, completely equipped, can be built into a 5x14-ft space.

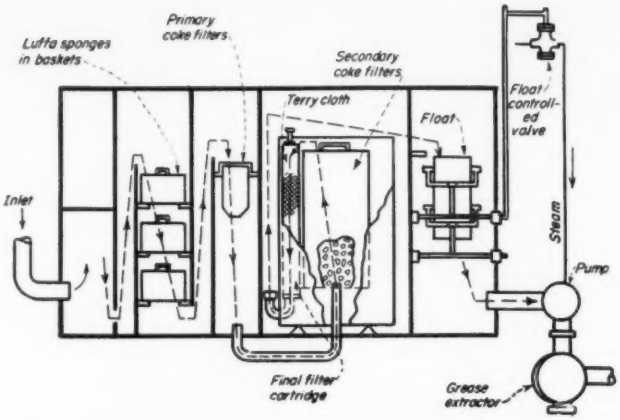
Ice Characteristics. Ice cakes are hard and solid but not brittle. Although visible to the eye the laminations are permanently bonded together. The ice melts, chips and fractures like ordinary ice. Its opacity due to dissolved gases in the water does not affect the cooling quality. Clarification has not yet been attempted. Performance has proved quite close to anticipation. Representative results are given in the table. It seems justifiable to rate the incremental freezing system as about 30 times faster than comparable can-ice plants.

Shear-off forces encountered in this machine suggest that its freezing surface could be increased safely to 10 sq ft. Output, noninsulated, should then exceed 92.5 lb per hr, while power costs should fall below 55 kwhr per ton. Use of Freon or ammonia instead of methyl chloride, and multicylinder installations should further improve the economy. Direct ice costs under $1 per ton seem likely where power rates permit.

The process should be applicable wherever white ice is acceptable. Since both investment and operating costs are low, extrusion equipment should appeal to many ice plants faced with replacement or expansion problems.



1 Light beam passing through small hole shows up oil in filtered condensate



2 First compartment catches surface oil and the condensate then passes through luffa sponges, two coke beds in series, and final filter of terry-cloth units

These Filters Clean Oily Condensate

Keeping oil out of boilers by wasting exhaust steam means heat loss and more treatment for raw makeup. Since both up costs, the thrifty answer may be one of these oil filters*

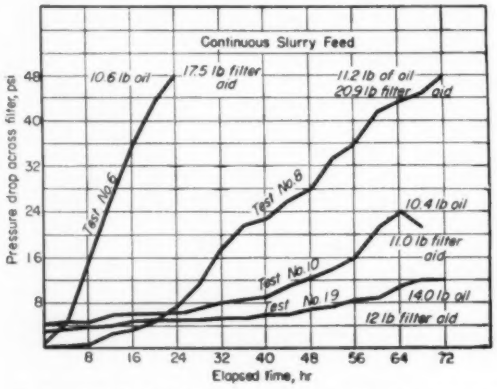
By **MORRIS BRADT**, *Chief Field Engineer*
Skinner Engine Co

► FROM A PRACTICAL STANDPOINT, successful operation of oil filters hinges on a dependable method for determining amount of oil in the filtered effluent.

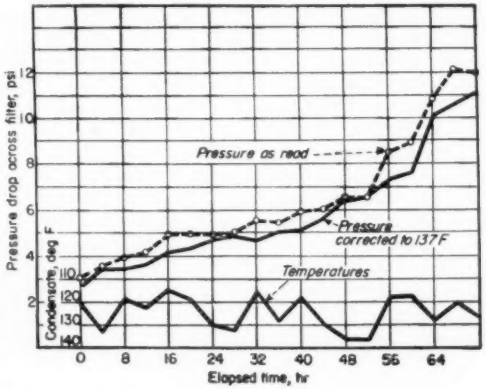
Tests for Oil. One method is to draw off a sample in a clean glass and allow it to stand. Then place it in proper position with a light so any free oil floating to the surface can be observed; emulsified oil clouds the filtrate. A tyndallmeter also determines the emulsified-oil content accurately. Another way is to extract the oil with a solvent, such as chloroform, evaporate the solvent, and weigh the residue. This is such a delicate operation that it is almost impracticable.

A simple device, Fig. 1, uses a lamp in the lower part to pass a light beam through a small hole into the container above. If the filtrate is pure, there will be no visible beam. Comparing prepared samples, having a known oil content, with the filtrate gives an indication of oil content. An experienced

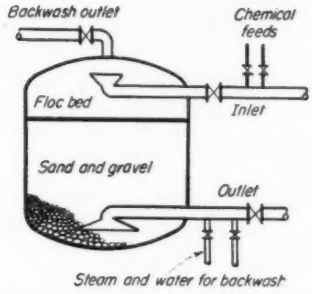
* Based on a paper presented before the ASME 68th annual meeting.



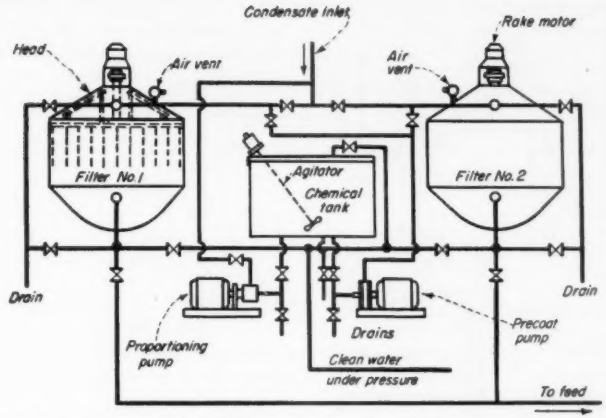
5 Pressure developed during tests are a function of the tests to determine proper type and amount of filter aid



6 Pressures developed during tests are a function of the elapsed time, but they are also affected by the temperature



3 Sand filter consists of bed of sand and gravel with floc layer on the top



4 This filter unit uses Anthrafilt as the filtering medium with a chemical proportioning tank, precoat and proportioning pump, side and top scrapers, rake

operator can dispense with the calibrated samples, as he will recognize the presence of oil without the comparison. An oil content of as little as 0.01 ppm produces a visible beam.

The type of oil-removal equipment required depends on:

1. Physical form of the oil in the condensate.
2. Method of boiler-water treatment.
3. Type of service.

Physical Form of Oil. Degree of tightness of emulsification deals with the stability and size of the oil particles held in suspension. The older-type steam engines, operated at low-speed and temperature, and cylinders were swept by low-pressure exhaust steam. This resulted in low-temperature cylinder walls, and more moisture in the exhaust from cylinder condensation. These factors resulted in most of the cylinder oil appearing as free oil in the condensate.

It was found that the exhaust from a single-expansion uniflow engine contained a much tighter emulsion and less free oil than that from a multiple-expansion engine. Various theories have been advanced about the reasons for this tightness. One is that velocity of the steam through the exhaust openings of the prime mover causes the particles to impinge on each other with a disintegrating effect. Another theory is that the drop in pressure, between the point of release and the lowest point arrived at, combined with the length of time required for this phase of the cycle, results in the dispersion of the larger oil particles, because of the re-evaporation of moisture present in the exhaust.

If this change in pressure is rapid enough, it approaches the action that takes place in an explosion; or, in other words, the shorter the interval of time and the greater the pressure drop, the smaller the resulting particle of oil.

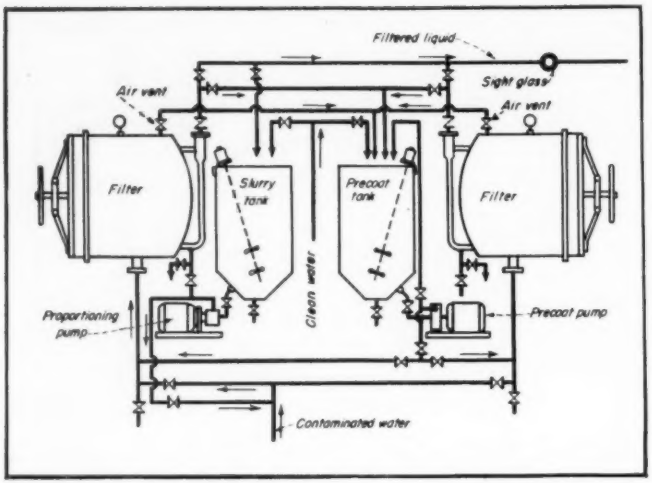
It has been definitely established that some oil particles in the emulsion are electrically charged and repel each other so they remain in suspension, while others that are uncharged coalesce into larger particles. These uncharged particles are called free oil. Presence of the charged and free oil introduces two different problems in removing oil from feedwater: removal of (1) the free oil and (2) the emulsified or charged oil.

Feedwater Treatment. Treatment of boiler feedwater is more important in connection with the oil-elimination problem than is generally recognized, for with certain types of treatment considerable oil can be present in feedwater without any resultant damage to the boiler. For example, a fleet of tugs with uniflow engines, which operate at comparatively high pressure and superheat, use simple coke boxes for removing the oil, with no boiler trouble. Water treatment used in the boilers has a colloidal base, which produces a sludge. The coke boxes do not break the emulsion, and so we must assume the emulsified oil enters the boilers where the emulsion is broken down and the oil absorbed by the sludge. Then when the sludge is blown out the oil goes with it.

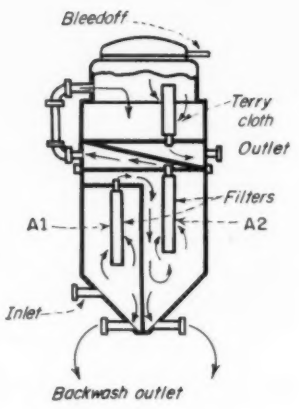
Another case illustrating the importance of feedwater treatment is the comparison of two identical dredges, neither of which had adequate filters. Dredge No. 1 operated in a river where the water contained from 2 to 3% silt. Boilers were washed with raw water from the river. The evaporators, used to supply makeup, often primed, so a slight amount of raw water carried over into the makeup. When the boilers were opened for inspection, a coating of dust (dried silt) was present on all surfaces. No tubes were replaced. About 4 quarts of engine cylinder oil were used per day.

Boilers on dredge No. 2 were washed with clean or distilled water. No priming was encountered in the evaporators. When the boilers were opened, tubes were found to be clean—there were no deposits of either silt or oil. Load carried by the boilers was the same as on dredge No. 1. But in eight months, 327 tubes had to be replaced because of warping, which resulted in damage to the vertical baffles and loosening of tubes in the headers. The boiler company changed the baffling, draft and everything else they could think of, but without success. Oil consumption of the engine was reduced to a half pint of cylinder oil per day. The troubles continued. Operators of this dredge then conferred with operators of dredge No. 1, and concluded that the boiler feedwater was too clean. After changing the feedwater treatment they had no further tube trouble.

Types of Filters. With the foregoing points in mind, choice of equipment narrows down to three types. Where only free oil is present (exceedingly rare), the choice is relatively simple. In fact, if the liquid contains free oil and is allowed to stand quietly for a sufficient length of time, free oil floats to the surface. Where operation does not allow this, passing the contaminated liquid through clean material, such as coke, sponges, vegetable fiber



7 Stripper units use a mixture of asbestos and diatomaceous earth to coat the filter element. After precoating operation the filter aid is fed continuously



8 Diatomaceous-earth stripper filter uses thin impregnated paper, terry cloth

or fabric units, removes the free oil.

Fig. 2 shows the construction and basic parts of a feed and filter box used in connection with older reciprocating engines. Water enters the first compartment, allowing a certain amount of free oil to rise to the surface. Clarified water passes beneath the baffle and through the luffa sponges, primary coke filter, secondary coke filter, and finally the terry-cloth fiber cartridge. It then passes into the float chamber, from which it is pumped to heater or tank. Pump speed is governed by the float-controlled valve to maintain as constant a level as possible in the float chamber.

Emulsified oil can be handled either by neutralization and absorption, or by neutralization and stripping. Neutralization and absorption use a diatomaceous earth or combination of chemicals that produces an electrically charged precipitate of "floc."

Sand Filters. Marine installations, made in 1934, using uniflow engines, which employ sand filters with alum and soda-ash floc, have proved very satisfactory so far as oil removal is concerned. No boiler troubles have been encountered because of cylinder oil in the feedwater. The filters, Fig. 3, are simple in mechanical construction but require a large amount of supervision.

Contaminated feedwater enters at the top, where chemicals in proper proportion to form a floc are introduced into the stream. This floc neutralizes the emulsified oil and forms a mat on top of the sand bed. The mat absorbs part of the oil and the remainder floats to the top.

After varying intervals of time, pressure differential across the filter increases to a point where it is necessary to backwash. This is done by cutting off the chemical feeds, removing the filter from operation, and admitting water and steam, or hot or cold water, into the filter bottom. From there it flows up through the bed and out. This backwash disperses the floc bed and floats it out the top, together with any free oil present.

One difficulty with this type of filter is controlling the chemical feed, for if the pH of the condensate changes, it is necessary to change the proportions of chemicals. Otherwise, they do not combine to form floc but pass through the sand bed to the boilers. A precoat of floc must be formed on the sand before filtration starts or the bed gradually becomes impregnated with oil. The sand then has to be washed with caustic soda or be renewed.

In operating this filter, the human element is of considerable importance because the bed has a tendency to channel, allowing raw water and the floc to pass through into the boiler. Oil may also creep down the side of the filter. And backwashing may require a lot of steam or water on some installations. If backwashing is not violent enough, the sand is not properly cleaned. If it is too violent, it tears up the bed, mixes the gravel and sand, and flushes sand out of the filter. Or, if not quite this violent, it washes sand out of the filter. On the other hand, sand filters have been in use for years without boiler troubles caused by cylinder oil.

Variation of Sand Filters. Mechanical changes in a later development of this type filter, Fig. 4, consist of adding a chemical proportioning tank and precoat pump, a rake, side and top scrapers, and Anthrafilt in place of sand. In operation, proper proportions of alum, soda ash and water are placed in the chemical tank to form floc. A pump introduces the preformed floc into the filter to coat the bed. When 0.16 lb of alum and 0.08 lb of soda ash per square foot of bed have been introduced, the pump is shut down. Filtration then starts. A proportioning pump feeds floc continually to the filter at a rate of 1.0 ppm of alum and 0.5 ppm of soda ash per 18.5 ppm of oil.

In backwashing, as soon as water starts to flow, the rake motor is started and run about 7 to 10 minutes. After this, the rake is shut down and water allowed to flow for another minute. The rake stirs the particles in the bed against each other and releases the oil and floc. Amount of water is controlled and reduced to 4 gal per sq ft per min, as against 8 to 12 gal per sq ft per min in a conventional sand filter.

In this filter, the water is used to float out oil and floc, and not for agitation. A filtering rate of 5 gal per sq ft per min is used, with a maximum of 7, thus reducing the chance of bed disturbance. The scrapers remove oil from sides and top quickly, and help prevent oil creeping down the tank side. Preformed floc eliminates troubles from changing pH values.

Diatomaceous Earth. In 1943 it was determined that diatomaceous-earth filters were best for removing oil from condensate. When introduced into condensate and deposited on screens or other supports, diatomaceous earth forms a porous cake, which absorbs or adsorbs oil and at the same time neutralizes the electrical charges in the oil particle. Length of filtering cycle depends primarily on pressure drop across the bed. This pressure drop is greatly affected by the grade of filter aid used. Two types of filters—the "continuous slurry feed" and the "stripper"—use diatomaceous earth.

Fig. 5 shows the pressures developed in the continuous slurry feed filter. The four curves are from tests conducted to determine the proper amount and type of filter aid. Results shown in test No. 19 are about like those obtained at the present time in commercial operation. Length of the cycle has been increased to where the total operating time is as much as 120 hours.

Temperature of condensate passing through the filter is also important. Fig. 6 shows the temperatures carried during test No. 19. Pressures developed were found to be a function of the elapsed time, but were affected by the temperature as well. The calculated curve shows the actual pressures corrected to 137 F.

A practical demonstration of the effect of temperature was recently shown where the unit had a filter cycle of 120 hours with properly controlled temperatures. At the start of operation, this unit had cycles as short as 24 hours when excessive pressures developed. It was found that the temperature of the condensate was as low as 60 F, because of excessive use of cold circulating water in the condenser.

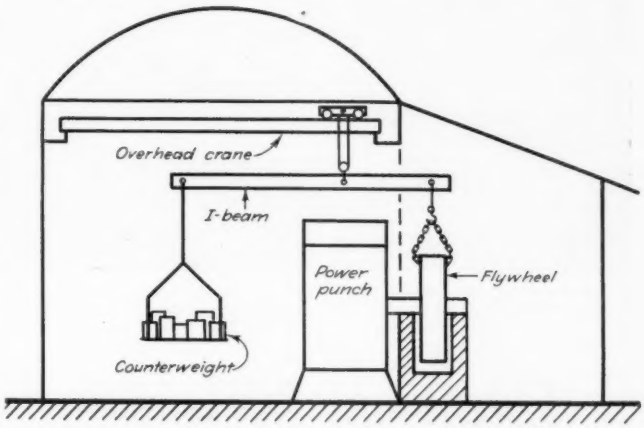
Fig. 7 shows a stripper-type unit. Filters and tanks are filled with water, and ½ oz of asbestos and 1/6 oz of diatomaceous earth per square foot of filter-screen area are added to precoat the beds. The mixture of water, asbestos and earth is circulated through the filter until all asbestos and earth are deposited. Filtration is now started. Filter aid is added to the water in slurry tank in an amount equal to about 8 lb of earth per gal of oil to be removed in 24 hours.

Neutralization and Stripping. Diatomaceous earth, with a tightener, is fed to the filter, Fig. 8, and precoating forms a thin layer on the filter base. The earth neutralizes the emulsified oil and, because of the tightness of the cake, the oil is then stripped from the feedwater and floats to the top of the vessel, where it is bled off. Oil passing through the tightened cake is finally eliminated by a terry-cloth element. Filters *A1* and *A2* are cylinders built of thin paper impregnated with a waterproof resinous substance.

In operation, filter elements *A1* and *A2* are coated and condensate passes through them and terry cloth in series. The coated filter elements break the emulsion, and change it to free oil. Major portion of this free oil floats to the top of each section and is bled off. Final condensate cleaning is done by the terry-cloth element. When pressure reaches a predetermined point, or oil is found in the filtrate, the unit is backwashed with steam to remove the coating on the filter elements. A solution of water and soap with pulsating admissions of steam washes the oil out of the terry cloth.

The three main classifications of filters described are all capable of producing a filtrate with an oil content far below the specifications set up by the U. S. Navy and U. S. Maritime Commission, which is a maximum of 0.10 ppm of oil in feedwater. Selection can be made on this basis.

Acknowledgment. The author wishes to express his appreciation for the information received through the courtesy of Arthur C Rohn, Director of Design, U. S. Maritime Commission; Skinner Engine Co; Johns-Manville Sales Corp; Davis Filtration Equipment Co, Inc; Permutit Co; Bowser, Inc; Skinner Purifiers, Inc; Republic Filters, Inc; and members of the organizations of George G Sharp and Gibbs & Cox.



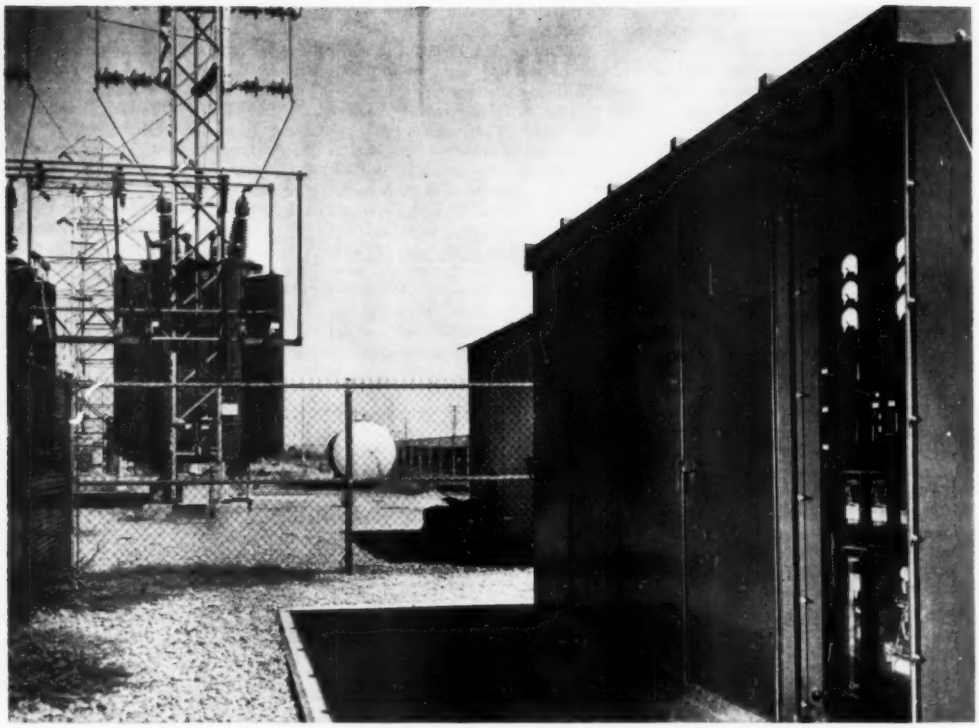
Weighted I-Beam Helps Crane

► Ingenuity, coupled with available equipment, can save hours of manual labor, especially when a job involves moving parts of heavy machinery.

Engineers at Lehigh Structural Steel Co, Allentown, Pa., were faced with such a problem when they found it necessary to lift a 5-ton flywheel from a punch press located just beyond reach of the shop overhead crane. Punch press stood near one building wall with the flywheel extending into an adjacent building, which was not equipped with a crane.

The job was licked by hanging a suitable I-beam on the overhead crane hook and positioning the crane over the punch press. Chaining one end of the beam to the flywheel the men added a balancing amount of weight to the other end. It was a simple matter then to lift the complete assembly and move the flywheel out of the way to permit replacement of worn bearings.

In comparison to jacking the flywheel out of place, this method eliminated many manhours of hard work, for which considerable money would have been spent. Accident risk was also greatly reduced because a flywheel or other round object is dangerous to handle by jacking and blocking.



1 Incoming utility high-tension lines in the background are double-duplex, 110-kv, 3-phase. One line is for emergency use and will cut in automatically if power should fail in the other. Utility metering structure lies beyond the switchgear

Electrical System in Columbia Steel

Reliability is the keynote of new electrical distribution and rectification system installed at Columbia Steel Co. mill, Pittsburg, California. It is part of a long-range program

► NEW EQUIPMENT for the production of cold-reduced flat-steel products has been added to this plant, representing an electrical load of approximately 30,000 kva. All electrical power is supplied by an outside utility, and enters cold-mill motor room at 6.9 kv. Much of the power is converted to dc for processing, with the Ward Leonard system of control used extensively.

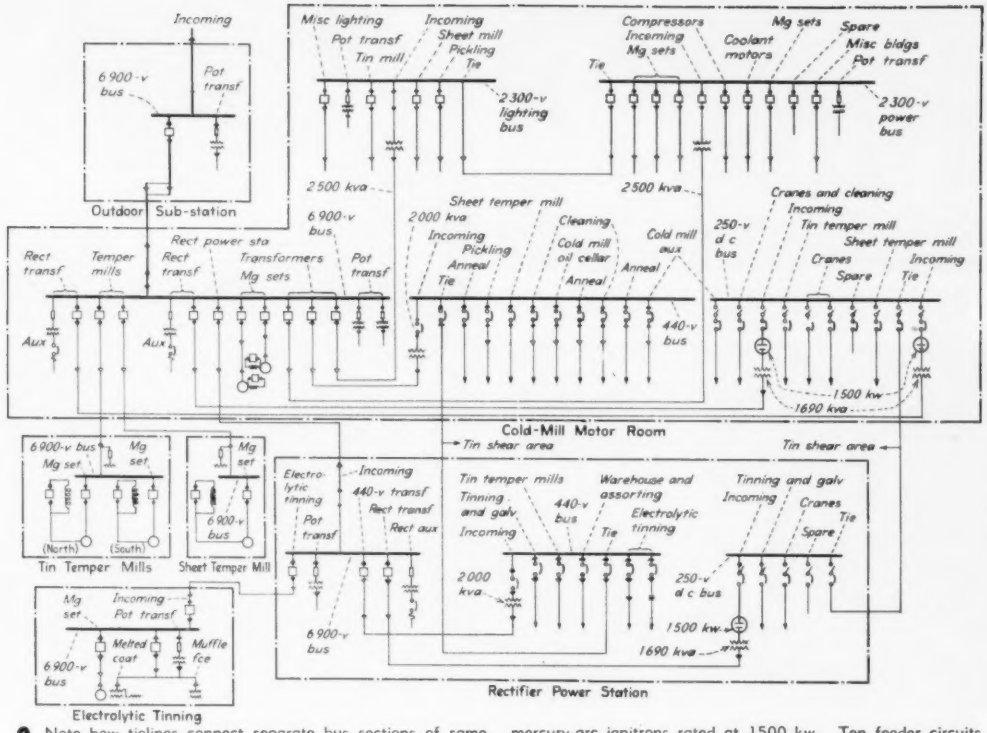
Incoming Line. Power for the new sheet-and-steel mill is supplied from the No. 2 utility substation extension. The substation has four 10,000-kva transformers, one of which is spare. Utility metering structure is located at this substation.

Nine single-conductor 1,000,000-cm cables run underground in nine 3-in. conduits, from the utility-metering structure to a 2000-amp dummy breaker in Co's portion of the No. 2 substation. This dummy is a section of the outdoor metalclad switchgear.

Power to the mill is distributed from two substations inside the plant buildings, one located in cold-mill motor room and the other in power-rectifier station. Motor-room incoming-line feeder starts from a 2000-amp breaker in No. 2 substation and ends at a 2000-amp dummy breaker in the cold-mill motor room. This feeder consists of six 3-conductor 500,000-cm cables in six 4-in. Transite conduits.

Mill 6.9-Kv Switchgear. Ten feeder circuits branch out of the 6.9-kv switchgear in the cold-mill motor room through 1200-amp breakers, Fig. 2. First is a feeder consisting of two 3-conductor No. 4/0 cables between the cold-mill motor room and the power-rectifier station. They run in separate conduits from motor room to a dummy breaker in the power-rectifier station.

The second line runs between the motor room and the 6600-hp motor of the No. 1 mg set in the cold-reduction mill. This line is made up of two 3-conductor 500,000-cm cables. A third line runs to the 13,300-hp motor of mg set No. 2 in the cold-reduction mill. This line consists of three 3-conductor 500,000-cm cables.



2 Note how tielines connect separate bus sections of same voltage for greater reliability. All rectifiers shown are mercury-arc ignitrons rated at 1500 kw. Ten feeder circuits from cold-mill room 6.9-kv bus run through 1200-amp breakers

Mill Will Handle 30,000-Kva Load

Fourth feeder (one 3-conductor 500,000-cm cable in a 4-in. conduit) runs to the entrance compartment in tin-temper-mill basement. From a 1200-amp breaker at the north tin-temper-mill basement a line runs to the 2970-hp motor of the mg set in the north tin-temper mill. This line is a single 3-conductor 350,000-cm cable in a 4-in. conduit. A similar line runs to the south tin-temper-mill mg set.

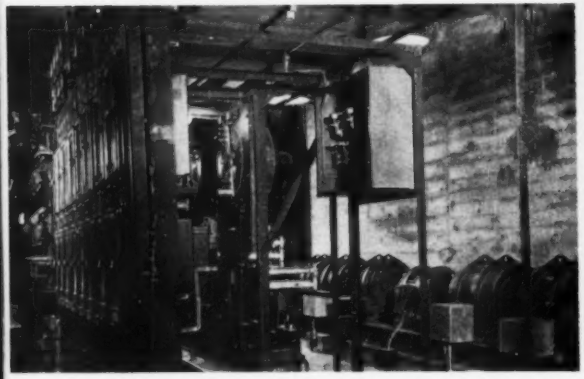
A 3-wire No. 4/0 cable was then run in a 4-in. conduit for the fifth circuit, which feeds to the entrance of sheet-temper-mill basement. From a 1200-amp breaker in the sheet-temper-mill basement, a line runs to the 2500-hp motor of sheet-temper-mill mg set and is a 3-conductor 350,000-cm cable in a 4-in. conduit. Now the sixth line runs to a 2500-kva 6900/2300-v power transformer in the cold-mill motor room. Once again this is a single, 3-wire, No. 4/0 cable in a 3½-in. conduit. A similar circuit runs to the 2500-kva 6900/2300-v lighting transformer in the cold-reduction-mill motor room. An eighth circuit feeds a 2000-kva 6900/440-v power transformer in the cold-mill motor room and consists of a single, 3-conductor No. 4/0 cable running in a 3½-in. conduit. The 1690-kva rectifier transformer No. 1 at cold-mill motor room is fed by a single 3-conductor No. 4/0 cable, running in a 3½-in. conduit. Last circuit branching out of the 6.9-kv switchgear in the cold-mill motor room supplies 1690-kva rectifier transformer No. 2 in cold-mill motor room. This is handled through a single, 3-conductor, No. 4/0 cable running in a 3½-in. conduit.

Power-Rectifier Station. Three main feeder circuits, carried in 3-conductor No. 4/0 cables in 3½-in. conduits, branch out of the power rectifier station through 1200-amp breakers. The first runs to a 1200-amp incoming-line breaker in electrolytic-tin-line basement.

From the incoming-line breaker there are two lines, one supplying power to the 500-hp motor of the mg set in the electrolytic-tinning line and the other running from the breaker in basement to the electrolytic-tinning line. The latter supplies power to two 500-kva single-phase transformers and two 500-kva single-phase reactors in addition to a 75-kva single-phase transformer. Second main feeder line runs from the breaker to a 2000-kva 6900/440-v transformer at the power-rectifier station, while third main line runs from breaker to 1690-kva rectifier transformer at station.

Cold-Mill Motor Room. Incoming line to 2300-v power-unit substation in cold-mill motor room is from a 2500-kva 6900/2300-v transformer in motor room

3 Power-transformer secondary feeds anodes of 1500-kw mercury-arc rectifier; dc output used for electrolytic tinning



4 One motor drives all six generators shown to right. Their output feeds fields of mill motors and other generators

5 Modern metalclad switchgear to left and control board on right handle the 6900-v ac power in cold-mill motor room

to 1200-amp incoming-line breaker. Incidentally, eight feeder circuits are fed through 600-amp breakers from the power-unit substation.

The first of the eight runs from power-unit substation to administration building, hospital, industrial-relations building and yard area. This circuit furnishes both power and light. From power-unit substation, a second line runs to the 300-hp motor of the auxiliary sheet-shearing line motor-generator set. The 250-hp motor of this side-trimming and recoiling-line motor-generator set in control basement *F* constitutes the third circuit and feeds through a synchronous-motor starter. Fourth line runs from substation to a 3-way "tee" splice box. Two branch lines leave the splice box: one goes to the 500-hp motor of the 54-in. cleaning-line motor-generator set in control basement *C*; the second branch runs to the 400-hp motor of the 38-in. cleaning-line mg set at control basement *D*.

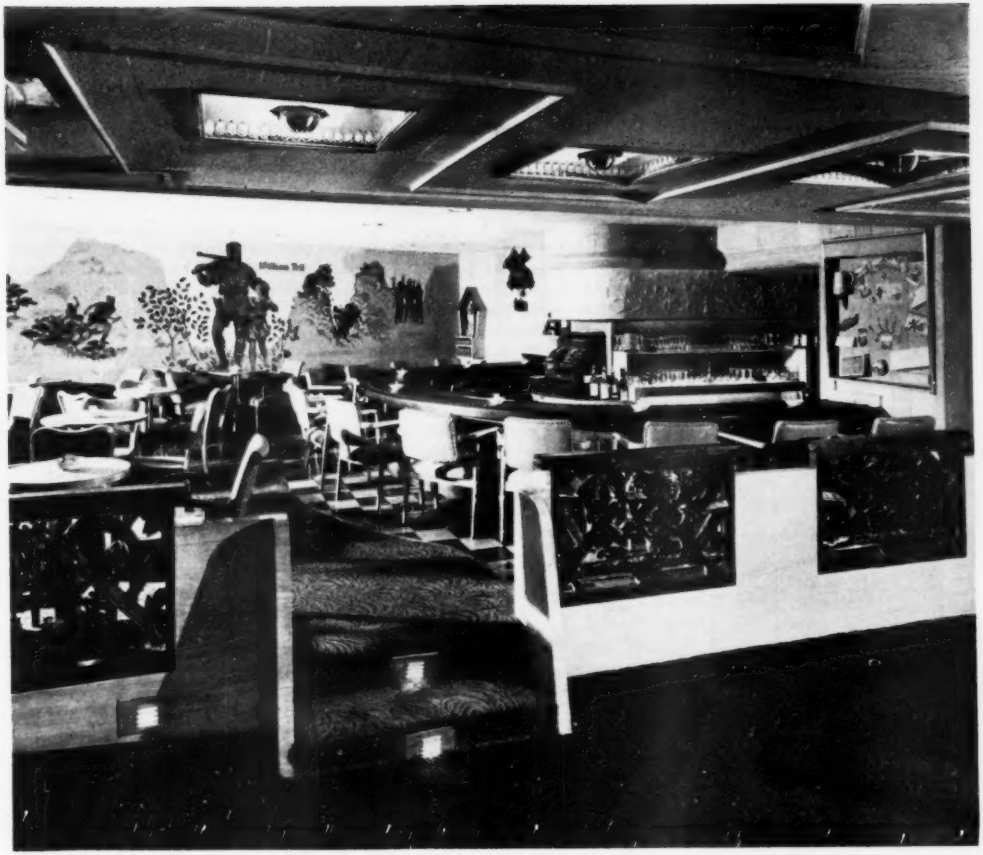
Fifth 2.3-kv circuit from the power-unit substation in the cold-mill motor room runs to synchronous-motor starters No. 1 and 2 at control basement *B*. The first starter is for 400-hp motor of pickling line No. 1 mg set. Second starter controls 400-hp motor of the No. 2 motor-generator set of the pickling line. Cubicle at boiler plant takes the sixth line, and from there separate lines run to each of the two motors (rated at 350 hp each) operating air compressors. Two 400-hp roll-coolant motors (No. 1 and 2 at the motor-room oil cellar) are fed by the seventh line. Feeder No. 8 runs to tie compartment at lighting unit-substation. This circuit is a tie between power unit and lighting unit-substation.

Lighting Unit-Substation. Incoming line to the 2300-v lighting unit-substation at the cold-mill motor room is from 2500-kva 6900/2300-v transformer at the motor room. Four feeder circuits emerge from lighting unit-substation through 600-amp breakers. First runs to gate-house, vaults No. 1, 4, 7 and 8, the track-scale house, change-house *A*, yard, fence and dock area. Second circuit supplies sheet-mill area. Included in this circuit are seven lighting platforms, vault No. 6 and the superintendent's office. Line three runs to the pickling area and includes cold-mill motor room, oil cellar, annealing basement, and four lighting platforms. Fourth circuit supplies the tin-mill area. Power requirements in this area include vault No. 5, south track-scale lighting, south-area fence lighting and eight lighting platforms.

The 440-v unit substation in the cold-mill motor room is fed from a 2000-kva 6900/440-v power transformer. Ten feeder circuits leave this substation, with all but one feeding through an 800-amp breaker.

Likewise, the incoming line for the 440-v unit-substation at the power rectifier station is from a 2000-kva, 6900/440-v power transformer to a 4000-amp breaker in the 440-v unit-substation. Six feeder circuits stem from this point as shown in Fig. 2.

This by no means completes the story of the electrical distribution in this plant. Nevertheless, the general trend has been outlined and the remainder of the work may be followed by close study of diagram on the preceding page.



1 Basic ventilation requirements for much used hotel spots, like the William Tell Cocktail Lounge of the Bismarck Hotel, Chicago, call for frequent air changes. Any already conditioned air, recovered and reused, means dollar savings

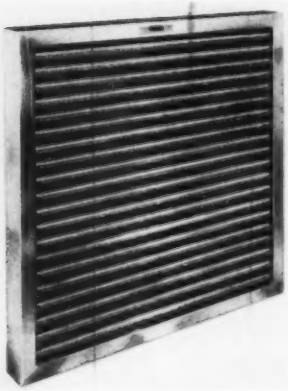
Hotel Men Study Air-Recovery Savings

Today's hotel men believe in lots of air conditioning. If anything can stretch air-conditioning dollars they want to know about it. Here's a report, prepared for American Hotel Assn by York Research Corp, on what air recovery does

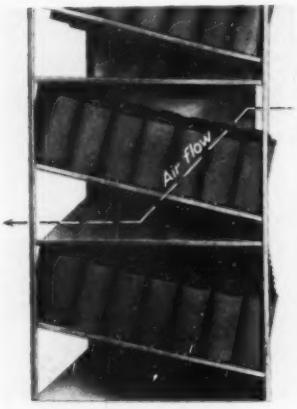
► USE OF OUTSIDE AIR in an already conditioned space depends on two significant qualities that this air would bring into the space: (1) vitality (2) freshness. These two qualities form the basis for ventilation standards. A certain minimum volume of outside air must be admitted to any closed area to maintain these standards. Many cities have local codes that set the lower limit for quantity of outside air. But to supply more outside air than needed merely adds to the cost of air conditioning, table on p 91—a situation to avoid.

So the service department of the American Hotel Assn had the York Research Corp of Connecticut investigate the problems growing out of recirculating already conditioned air. Here is what they found.

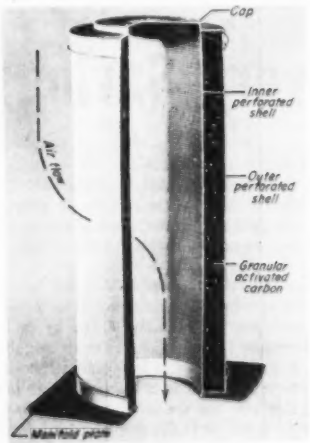
Qualities of Outside Air. Of the two most valuable inherent qualities in outside air, just mentioned, vitality comes entirely from oxygen in the air, roughly 21% by volume. Cheapest, easiest way to replenish it is to bring in more outside air. On the other hand, freshness or, more properly, the degree of freshness is a measure of relative freedom from entrained impurities. Here then is



2 Air-recovery panel of carbon-filled tubes fits in behind the dust filter



3 Canisters mounted on manifold plates are put in the duct work at an angle



4 Arrow traces path of odor-laden air flow through the activated carbon

a point of control over the air quantity.

If some method exists for freshening, that is, removing entrained impurities in a conditioned air, then the only job that outside air need do is supply the vitalizing factor. Just how big a job is this? Only a negligible amount of outside air need be supplied to meet oxygen requirements. In fact, unavoidable infiltration usually exceeds in volume the outside air necessary.

What then can be done about the other side of the problem, cleaning up air-borne impurities, particularly those most troublesome to hotel men? There are four general sources of air-borne impurities. They are dust, smoke, bacteria and gases or vapors. Nature and concentration of these impurities determines the purification methods.

Removing Impurities. Air filters take out dust; electrostatic filters remove smoke particles and ultra-violet rays eliminate bacteria. For gases and vapors some means of diluting the concentrations proves effective. This dilution may be by (1) condensation by reducing air temperature (2) air washing or scrubbing (3) adsorption. The first two methods involve rather heavy costs and often prove impracticable. The principle of adsorption, however, can usually be applied at a reasonable cost.

Gases and vapors most troublesome to hotel men are those attributed to guests and their habits—tobacco, smoke, cosmetics, liquor, food in preparation and serving. These air-borne "impurities" can be removed readily by the adsorption methods.

The principle of adsorption has been known for years. The gas mask offers the most generally known example. In the air-recovery system using adsorption this same principle is put to work with activated carbon as the adsorption medium. Gases and vapors are picked up by the activated carbon particles much as a sponge soaks up water.

The air to undergo odor and gas removal passes through carbon-filled tubes in a panel, Fig. 2, or through canisters mounted in the duct work, Fig. 3. (These devices will be discussed at length later in the article.) There is a limit, though, on how much of these impurities can be adsorbed by a unit weight of activated carbon.

Type and grade of carbon employed in air-recovery systems retains its effectiveness until it has adsorbed up to about 20% of its own weight. When this degree of saturation has been reached the carbon can be reactivated. This reactivation merely releases and disposes of all adsorbed substances to restore the carbon to its usual potency.

Usual practice for reactivation involves returning panels, Fig. 2, intact to manufacturer and replacing with ones ready for service. For large installations, such as Fig. 3, the individual canisters, Fig. 4, are returned. For some of the very largest systems the individual canisters are emptied and recharged from a supply of activated carbon kept on hand. The emptied carbon is sent in bulk for reactivation.

Application to Air Conditioning. But first let's see where air-recovery units fit into hotel operations and air-conditioning systems. There are three basic jobs air-recovery can do: (1) Purify contaminated intake air. (2) Purify contaminated exhaust air. (3) Reclaim stale air from recirculating air.

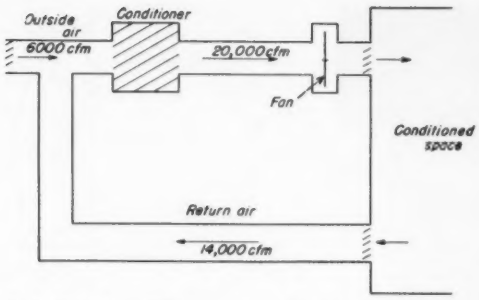
First of these three basic hotel-service jobs—purifying contaminated intake air—serves in those occasional installations where outdoor air is contaminated by neighboring industries.

Second applies to hotel installations where exhaust air from kitchens, etc, enters into light shafts or courts. In each of these first two cases, the activated carbon is placed in the path of the offending air.

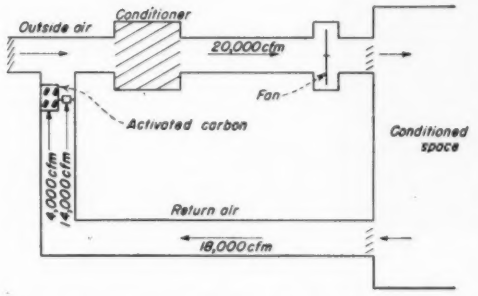
Third type of air recovery for air-conditioning systems—reclaiming stale air—has the most general application and gives the best opportunity for reducing costs. Cost reduction can come about from one of four installations: (1) new systems to reduce tonnage capacity of conditioning equipment (2) existing systems to lower operating costs by reducing amount of outdoor ventilation (3) existing systems where introduction of adequate ventilation creates temperatures above or below those desired (4) existing systems where a maximum outdoor air still fails to control odors. (Air-recovery equipment here has the effect of further diluting the recirculated air.)

Usual location for air-recovery equipment in systems where it reclaims stale air is in the return-air side, Fig. 6. It should be protected by standard air filters large enough to keep dust from settling out on the activated carbon. Oil-dipped filters should be avoided because oil vapors and droplets released into the passing air stream become adsorbed by the activated carbon. The extra loading, of course, limits the carbon's capacity for cleaning up odors and other impurities in the returned air.

Possible Savings. In the simplified system in Fig. 5 the conditioned space load calls for 20,000 cfm. Of this amount, 14,000 cfm can be recirculated. The remainder of 6000 cfm—for freshness and vitality—consists of outside air. By putting in adsorption equipment in the return duct of the air-conditioning system, 18,000 cfm (4000 more than above) of the circulating air comes from recovered air, that is, air that has already been conditioned.



5 Typical air-conditioning system brings in outside air to replenish oxygen supply and freshen up conditioned space



6 Use of air-recovery equipment in return duct cleans up conditioned air, cuts required outside air to code minimum

TABLE SHOWING THE COMPARISON IN COST OF OUTSIDE AIR VS. RECIRCULATED AIR

Cost to condition 4000-cfm outside air per yr	
Refrig machine: 12 tons at $300 per ton	$3600
Heating equip: 400,000 Btu x 2c per Btu	800
	$4400
Interest and amortization: $4400 at 15%	$ 660
Power costs: av of ½ load; 6 ton x 1200 hr x 1 kw x 1c per kwhr	72
Oil costs: av of 1.8 gph x 3000 hr x 7c per gal	378
Total costs, per yr	$1110
Cost to recover 4000-cfm return air per yr	
Air-recovery equipment	$ 696
Interest and amortization: 696 at 15%	$ 104
Carbon reactivation: once per yr plus labor, etc	370
Total costs, per yr	$ 474
Net savings in air recovery per yr: $1110-474	$ 636

At an estimated figure (see the table) of 3 tons of installed refrigeration machinery per 1000 cfm of air to be conditioned, reusing conditioned air means a saving of 12 tons of refrigeration capacity. By figuring on the safe side at $300 per ton for installed refrigeration capacity, this gross saving in first cost amounts to $3600.

But since installed costs of the air-recovery system itself runs about $696, net savings drop to $2904. When amortization, interest on the investment, and operating costs are added the expected annual saving amounts to around $636. These figures apply only to the cooling cycle.

Air-Recovery Equipment. There are two commercially available forms of activated carbon available for air-recovery service. These recovery units can be either carbon-packed tubes mounted in a panel, Fig. 2, known as Type *G*, or carbon-filled canisters mounted on manifold plates, Fig. 3, 4, and called Type *H*.

The panel-mounted tubes come in several standard sizes varying from 20 to 25 in. by 16 to 24 in., with one, two and three rows of tubes and four different tube spacings. Alternate rows are staggered with respect to each other. This increases the contact between air stream and activated carbon surface. Choice of size and spacing depends on air-volume percentage—flowing through a duct or casing—which is to be recovered. The tube-type serves particularly well in comfort air-conditioning systems where concentration of impurities is of moderate intensity. This type can be easily fitted into package or self-contained air conditioners, unit heaters and cold diffusers.

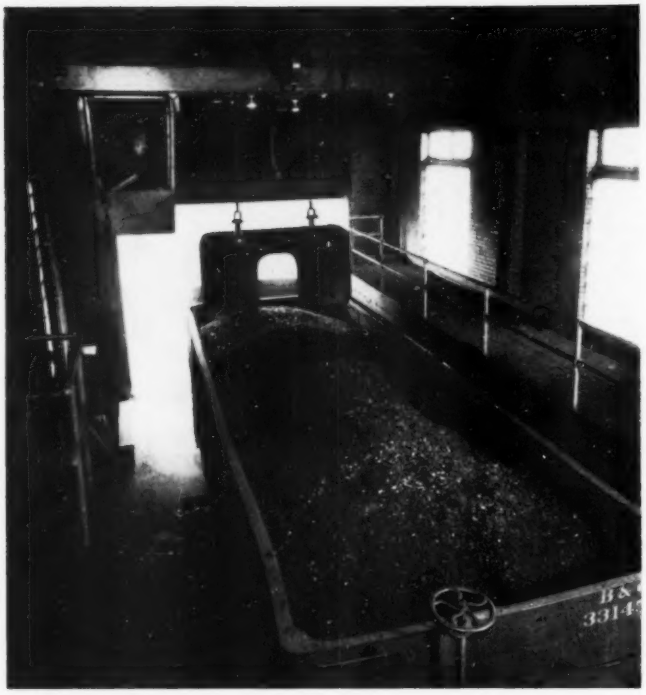
Canisters, Fig. 3 and 4, are put up in three standard sizes depending on thickness of the carbon bed. This thickness, in turn, has a direct relation to the nature and degree of air contamination to be handled. The granular activated carbon is poured into the annular space between the inner and outer perforated cylindrical shell, Fig. 4.

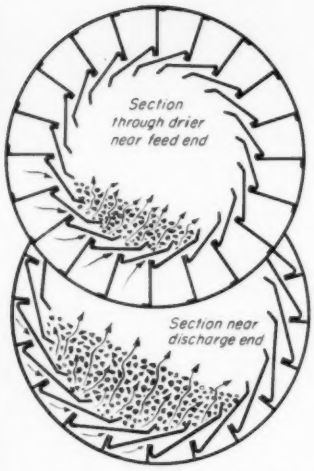
The individual canisters mounted on manifold plates are set up in the duct work in either a horizontal or a sloping position, Fig. 3. The sloping position (at an angle of 14 deg from horizontal) staggers the air entry and exit openings vertically with respect to one another. This produces a reduction in over-all height. Width the canisters take up is usually the same as the width of any dust filters used. Depth varies from 1 ft. 5 in. to 8 ft. and height from 1 ft, 6 in. to 15 ft. 6 in. In extreme cases this depth may be increased.

CORRECTION

In the summary article of the Smoke Prevention series, April, POWER, p 120, there was an error in the "Underfeed Stokers" column. The last sentence in next to last paragraph should read:

"A rule of thumb for underfire draft calls for 1.0 in. for each 10 lb of coal burned per sq ft per hr."





2 Cross section of rotary drier, Fig. 3, shows louvers taper toward discharge

1 Clearing cars of coal that hangs up may be slow work but it's not too difficult with aid of one of the displacers available and operation by power crane

Coal-Handling Headaches And Some of Their Cures

A boiler plant may have a series of hang-up problems in cars, track hoppers, conveyors, bunkers, and chutes to stokers or pulverizers. Here's an analysis with suggested solutions

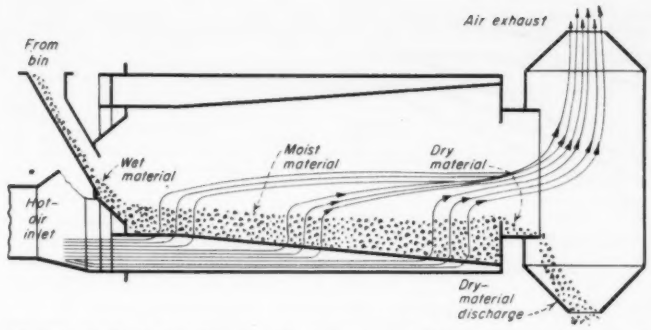
By **WILBUR G HUDSON**, *Consulting Engineer, Chicago, Ill.*

► WHEN SMALL-SIZED bituminous coal was made available to power plants at prices lower than stoker sizes, the operating engineer found his coal-handling headaches increasing. A system that successfully handles larger coals developed several difficulties when handling smaller sizes. This is particularly true when the latter are wet.

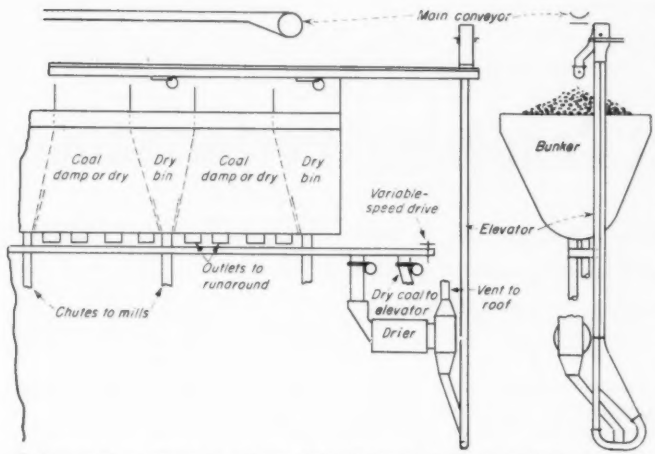
When dry, small-sized bituminous coal has an angle of repose of about 45-deg. the repose angle increases, with increasing surface moisture, to 60 or 70 deg. When packed as after standing in a bunker, for instance, these coals hang up and arch under. Oil-spraying them sheds rain from ground-storage piles and reduces the dust nuisance, but adds little to help the coal flow. Also, oil-sprayed coal cannot be handled for long on natural-rubber-covered belts. Synthetic-rubber coverings are required.

Clearing cars of coal is slow work, but not too difficult with the aid of one of several displacers that are available, Fig. 1. If track-hopper sides are sloped at 60 deg, or more, small coals flow to feeders and conveyors.

Small bituminous and No. 3 and 4 anthracite buckwheat adhere so tenaciously to the surface of a belt that the usual scraper or rotary brush will not clear off. As a result the coal builds up on the lower tripper pulley and on the return idlers, making training of the belt difficult and causing errors in weight readings if a weightometer is used. Multiple diagonal scrapers are quite effective, however. Elevator capacity gradually decreases because the



3 This longitudinal section through a rotary coal drier illustrates the flow of material and gases while drying progresses from the feed end to discharge end



4 Layout of equipment to dry wet coal with conveyor system to discharge to all bunker sections if coal flows, and to alternate sections if coal's not flowable

buckets do not completely clear their loads.

Bunker Problems. Most serious difficulty is in the bunker where outflow through discharge openings is practically impossible without continued probing and air-jetting. Since high moisture-content coal does not flow easily we must improve it by drying or other means. Though this is not practicable at a rate approaching the capacity of the main conveying system, it is interesting to consider the possibilities.

Coal freshly deposited flows more readily than that which has been compacted. If moisture does not exceed 15%, some fine coals will flow from the bunker openings with occasional probing or jetting. Fig. 4 shows a layout with a horizontal run-around continuous-flow conveyor, which is self-feeding to capacity from multiple, closely spaced bunker openings. A rotary drier and the equipment for re-handling from the drier to dry-coal compartments in the bunker are also included. Bypassing the drier when the coal is flowable is a simple detail. The drier may be the rotary type, similar to Fig. 2 and 3. As the cylinder slowly rotates, the coal tumbles over itself, exposing each section of the mass to drying air or gas. A manifold restricts the gas flow to the covered louvers. Feed control may be by observation of the exhaust temperature chart. If the temperature rises above a certain value, feed rate is increased, and vice versa.

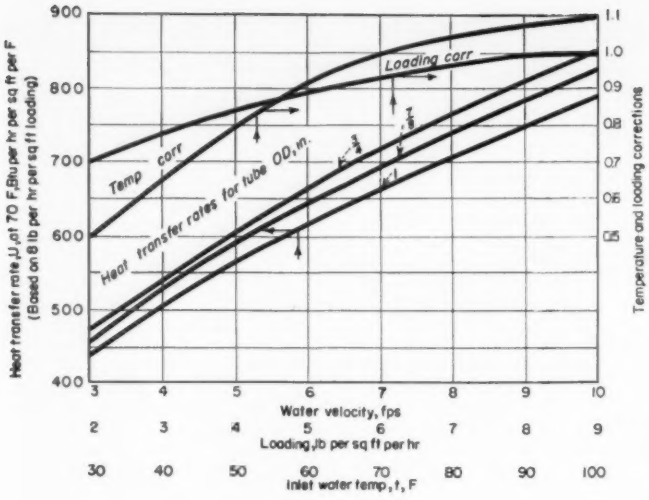
Feed-Chute Difficulties. If coal is not dry there is further difficulty in the feed chutes. This is less with outwardly flared stoker chutes, but some coals arch and hang up in the smaller chutes to pulverizers. Research by E F Wolf and H L Von Hobenleiten with semi-bituminous coals of Central Pennsylvania and West Virginia determined that this difficulty was substantially reduced by: (1) avoiding sudden constrictions and sharp changes in direction (2) minimum angle of convergence of lines of flow, preferably approaching zero (3) minimum practical taper in hoppers (4) use of round sections in preference to square or rectangular ones (5) maximum possible angle of inclination with the horizontal throughout.

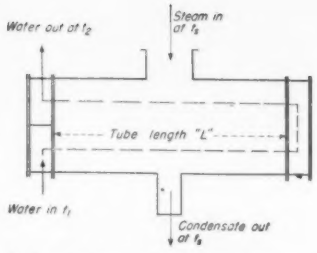
It is well-known that a vibrator attached to a chute improves the flow of dry sand, wood chips and some bulk chemicals, but is less effective with damp coal, which tends to pack when vibrated. Flow is improved in contact with glass, stainless steel and aluminum. The latter, now available at low cost, does have possibilities.

Recovery Problems. Where part of incoming coal goes to reserve storage it presents problems of recovery. The drag scraper functions nicely under average conditions and provides an inexpensive installation. In northern latitudes, severe winter conditions make stocking out and reclaiming more difficult. Where the reserve coal is frozen solidly as the pile builds up, shattering with explosives is about the only way to handle this mass.

The scraper-carryall towed by a tractor is quite widely used for moving both bituminous and anthracite coals. The bulldozer, self-propelled scraper, costs less than a carryall and tractor and is suitable for shorter trips. With either machine the coal may be spread out in thin layers, compacted by the treads and to some extent sealed to shed rainwater. Air circulation through the coal is prevented, which is an added advantage for coals that tend to ignite from spontaneous heating. If a frozen crust forms on the pile either the carryall or bulldozer can crack it and get loaded.

Anthracite coal behaves better than bituminous. It is less corrosive and usually flows freely. The smallest washed sizes do have the troublesome habit of hanging on when they should let go. Anthracite does not heat in storage. The great storage centers maintained by the producers stock out anthracite in the slack summer months and reclaim it in fall and winter. Some stocking out may be done in winter. I have seen the core of a 60,000-ton pile still frozen solid when reloaded the following October.


Heat transfer rate, U, at 70 F, Btu per hr per sq ft per F
(Based on 8 lb per hr per sq ft loading)
Temperature and loading corrections
Loading corr
Temp corr
Heat transfer rates for tube OD, in.
Water velocity, fps
Loading, lb per sq ft per hr
Inlet water temp, t, F



1 Principal temperatures governing performance are shown in above diagram

2 Heat-transfer and correction curves for calculating surface condenser performance when using ¾-, ⅞- and 1-in. tubes for certain loading limits

How to Predict Condenser Performance

Condenser performance calculations will be of help to both operator and designer in following existing units' operation or in comparing alternate condensers for future installation

By **GLENN C BOYER**, *Associate Professor, Mechanical Engineering Dept, Missouri School of Mines and Metallurgy*

► FINDING THE TUBE-SURFACE AREA needed to produce the desired absolute pressure in a condenser is a relatively simple procedure once certain fundamentals of condenser performance are understood. Condenser manufacturers have agreed that the heat-transfer values shown in the curves of Fig. 2 shall be used for calculating performance. In addition, they have set three limits on performance as follows:

1. Minimum water velocity of 3 fps through condenser tubes.
2. Minimum absolute pressure of 0.7 in. Hg in condenser shell.
3. Minimum terminal difference of 5 F $t_s - t_2 = 5$ F, (Fig. 1)

Performance guarantees are not made for water velocity, absolute shell pressure or terminal temperature difference values less than the minimum values given.

The tube surface area and cooling-water flow rate can be figured by using heat-transfer data in Fig. 2 and the following three equations.

$$\text{gpm} = \frac{950S}{500\,(t_2 - t_1)} = \frac{1.9S}{t_2 - t_1} \qquad (1)$$

where

gpm = cooling-water flow, gpm
S = steam condensed, lb per hr
t_2 = outlet-water temperature, F
t_1 = inlet-water temperature, F

$$A = (kL/V)\ \text{gpm} \qquad (2)$$

where

A = condenser surface area, sq ft
k = a constant (see Table)
L = tube length per pass, ft
V = water velocity, fps

$$t_2 = t_s - \frac{t_s - t_1}{e^x} \qquad (3)$$

where

x = (kL/V) (U/500)
t_s = saturated steam temperature corresponding to absolute pressure in condenser shell, F
U = heat-transfer rate, Btu per sq ft per hr per F lmtd

Equation 1 assumes that the quantity of heat removed from each pound of steam condensed in the unit is 950 Btu. The several condenser manufacturers agree to use this value when the purchaser does not specify the amount of heat to be removed from the steam. Should the amount of heat to be removed differ from 950 Btu per lb it will be necessary to use only the correct value in equation 1 in place of the 950.

Equation 2, to find the area, gives the relationship between surface area and internal cross-sectional area of condenser tubes. Equation 3 for finding t_2, temperature of the water leaving the condenser, develops from the basic heat-transfer equation:

$$Q = UA\Delta t_m$$

where

Q = total heat transfer, Btu per hr
Δt_m = logarithmic mean temp difference

How do these equations work? This question can best be answered by considering some sample problems.

STANDARD CONDENSER TUBE DATA

Tube OD, in.	Tube gage, Bwg	Tube ID, in.	Surface area, sq ft per ft length		Velocity, fps for	Value of k for number of tube passes		
			Outside	Inside	1 gpm	One	Two	Three
¾	18	0.652	0.1963	0.1706	0.9611	0.188	0.377	0.565
	16	0.620	0.1963	0.1613	1.063	0.208	0.417	0.625
	14	0.584	0.1963	0.1528	1.198	0.235	0.470	0.705
⅞	18	0.777	0.2291	0.2034	0.6670	0.155	0.310	0.465
	16	0.745	0.2291	0.1951	0.7360	0.168	0.337	0.505
	14	0.709	0.2291	0.1856	0.8126	0.186	0.372	0.558
1	18	0.902	0.2618	0.2361	0.5022	0.131	0.263	0.394
	16	0.870	0.2618	0.2277	0.5398	0.141	0.283	0.424
	14	0.834	0.2618	0.2183	0.5874	0.154	0.308	0.461

Example 1

Find the condenser area in sq ft and the quantity of cooling water flow, gpm, needed for the following conditions:

Steam condensed, S	25,000 lb per hr
Condenser backpressure	2 in. Hg abs
Steam temperature, t_s	101.1 F
Inlet-water temperature, t_1	80 F
Tube length per pass, L	14 ft
Water velocity, V	6.5 fps
Number of passes	2
Tube size and gage	¾ in., No. 18 Bwg
Cleanliness factor	0.80

From the table, find the value of 0.377 for k, then

$$kL/V = 14 \times 0.377/6.5 = 0.812$$

The heat-transfer coefficient U (uncorrected for loading, but corrected for temperature and cleanliness factor) is,

$$U = 690 \times 1.04 \times 0.80 = 574$$

where the basic value of 690 was found from Fig. 2. Solving for outlet-water temperature, using equation 3,

$t_2 = 101.1 - (101.1-80) / e^x$
$x = (kL/V)\ (U/500)$
$x = 0.812\ (574/500) = 0.933$
$e^x = 2.7183^{0.933} = 2.54$
$t_2 = 101.1-(21.1/2.54) = 92.8$ F
Check: $t_s-t_2 = 101.1-92.8 = 8.3$ F

Since this value exceeds the minimum terminal difference of 5 F, the calculations are satisfactory. From equation 1,

$$\text{gpm} = \frac{1.9 \times 25{,}000}{92.8-80} = 3700$$

From equation 2,

$A = 0.812 \times 3700 = 3000$ sq ft

Since the value of U was not corrected for loading it becomes necessary to check if such correction is needed:

$$\text{Loading} = \frac{S}{A} = \frac{25{,}000}{3{,}000} = 8.33 \text{ lb per sq ft}$$

Referring to Fig. 2 it will be found that no correction need be made for loadings in excess of 8 lb per sq ft.

Example 2

Now consider the same conditions as given in Example 1 with the exception of cooling-water inlet temperature, which is now increased to 85 F. Find the sq ft of condensing surface area and cooling-water flow that will be needed with this one changed factor.

$U = 690 \times 1.06 \times 0.80 = 585$
$x = 0.812\ (585/500) = 0.950$
$e^x = 2.7183^{0.950} = 2.586$
$t_2 = 101.1-(101.1-85)/2.586 = 94.9$ F
Check: $t_s-t_2 = 101.1-94.9 = 6.2$ F (greater than the 5 F minimum)

$$\text{gpm} = \frac{1.9 \times 25{,}000}{94.9-85} = 4800$$

$A = 0.812 \times 4800 = 3900$ sq ft

$$\text{Loading} = \frac{25{,}000}{3900} = 6.4 \text{ lb per sq ft}$$

Since the loading is less than 8 lb per sq ft, refer to Fig. 2, the loading correction of 0.95 will be found to apply. It will be necessary to correct the value of U already figured and recalculate the dependent quantities.

$U = 583 \times 0.95 = 554$
$x = 0.812\ (554/500) = 0.90$
$e^x = 2.7183^{0.9} = 2.46$
$t_2 = 101.1-(16.1/2.46) = 94.6$ F
Check: $t_s-t_2 = 101.1-94.6 = 6.5$ F

$$\text{gpm} = \frac{1.9 \times 25{,}000}{94.6-85} = 4950$$

$A = 0.812 \times 4950 = 4020$ sq ft

$$\text{Loading} = \frac{25{,}000}{4020} = 6.23 \text{ lb per sq ft}$$

Correction for a loading of 6.23 lb per sq ft (from Fig. 2) is 0.94 compared with 0.95 used for the loading obtained from the first calculation for the condenser area. Since the value of U would be changed only about 1% by using lower loading correction, calculations need not be revised further.

The 5-F increase in cooling-water temperature requires an additional 1020 sq ft of surface and 125 gpm of cooling-water flow to develop the same backpressure. These increments will vary of course depending upon the temperature level at which the increase occurs.

Example 3

If the steam flow through the condenser calculated in Example 1 decreases to 15,000 lb per hr, what will be the absolute steam pressure in the shell?

Cooling-water flow = 3700 gpm
Condenser surface, A = 3000 sq ft

$$\text{Loading} = \frac{15{,}000}{3000} = 5 \text{ lb per sq ft}$$

Correcting heat-transfer rate for new load condition.

$U = 690 \times 1.04 \times 0.80 \times 0.89 = 511$
$x = 0.812\ (511/500) = 0.830$

$$t_2-t_1 = \frac{1.9 \times 15{,}000}{3700} = 7.7 \text{ F}$$

$t_2 = 80+7.7 = 87.7$ F
$t_2 = t_s - (t_s - t_1)/e^x$
$e^x = (t_s-t_1) / (t_s-t_2)$

$$2.7183^{0.830} = \frac{t_s-80}{t_s-87.7} = 2.294$$

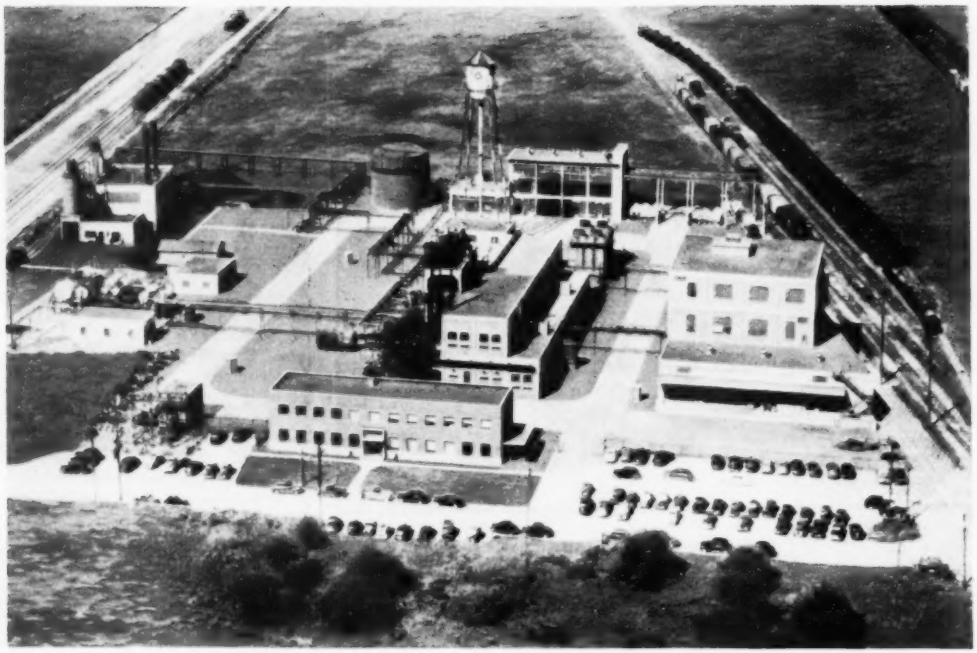
$t_s-80 = 2.294t_s-201.1$

$$t_s = \frac{201.1-80}{1.294} = 93.6 \text{ F}$$

Shell pressure = 1.59 in. Hg abs (corresponding to saturation temperature of 93.6 F)
Check: $t_s-t_2 = 93.6-87.7 = 5.9$ F

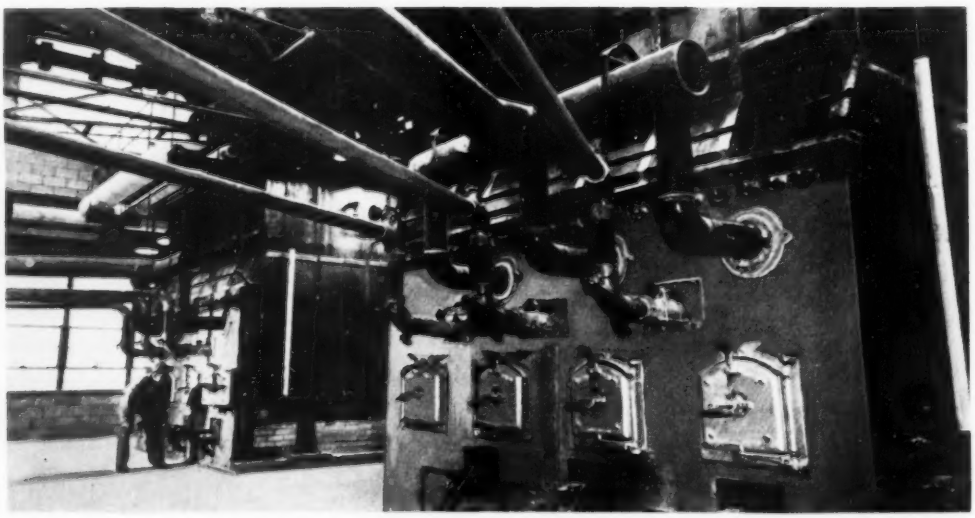
Since the terminal difference exceeds 5 F, the calculated performance can be realized.

These three examples outline the method of applying the basic data to predict performance and select the proportions of surface condensers. Studying these will suggest other ways of using this information to investigate performance behavior of condensers.

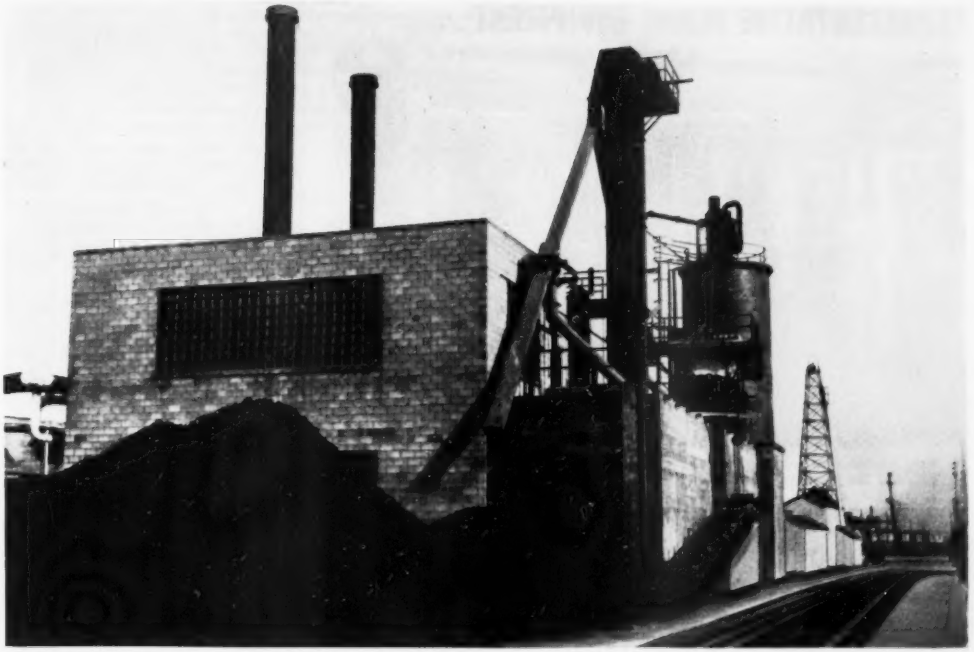


1 Glenn L. Martin Co's vinyl resin plant at Painesville, Ohio draws its power services from the plant located alongside the railroad tracks (upper left corner of photo). Division of load between electrical and steam demands affected design

Power Services Must Pay Off From



3 Fuel availability and fuel flexibility figured strongly in selection of steam-generating capacity. Coal gave best promise of continued availability so it was selected. Spreader stokers held out advantages from fuel-flexibility standpoint



2 Coal reaches the plant by rail. It is dumped onto a track hopper and removed from there either to storage (above) or by coal elevator to two 150-ton storage bins. A worm feed moves coal out of these bins and delivers it to spreader stokers

Start in Today's Industrial Plant

New vinyl resin plant of Glenn L Martin Co requires all its equipment to meet a short pay-off period to earn a place in production setup

► THE PROBLEM of just how much of the power services should be made part and parcel of a new plant differs with the nature of the plant and its product. The new vinyl resin plant of the Glenn L Martin Co of Painesville, Ohio, Fig. 1, is an illustration of a practical solution of this current headache. That solution revolves about the basic premise that all new plant equipment, power facilities included, should pay their own way from the outset.

Back in early 1947, the Blaw-Knox Co studied the power services required and weighed all in the light of a relatively short pay-off period. The anticipated steam and power loads looked like this: (1) Steam at 125 psi would average for summer-load 19,150 lb per hr, and for winter 35,350 lb per hr with a peak of 45,750, which included both process and heating needs. (2) Electrical-energy demand would average year-round about 2000 kw and have a 2600-kw peak. Over and above these basic requirements was the nature of the load for process steam. Indications showed it to be a widely fluctuating one.

So a number of schemes presented themselves for consideration. These schemes fell into one of two broad classifications—either a plant complete with facilities for generation of electric power, or a plant to furnish all power services except electricity, which would be purchased from the local utility.

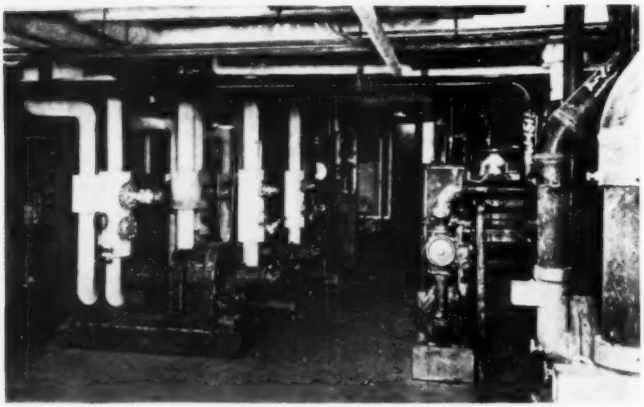
Among the proposals for a complete power plant was a scheme employing boilers operating at both 600 and 250 psi. The 600-psi units would supply turbine-generators capable of meeting the full electrical load, whereas the 250-psi boilers would add their output to exhaust from the turbines for all process-steam requirements.

An alternate plan involved a diesel as the prime mover for the electric-energy source and 250-psi boilers for steam for process and heating.

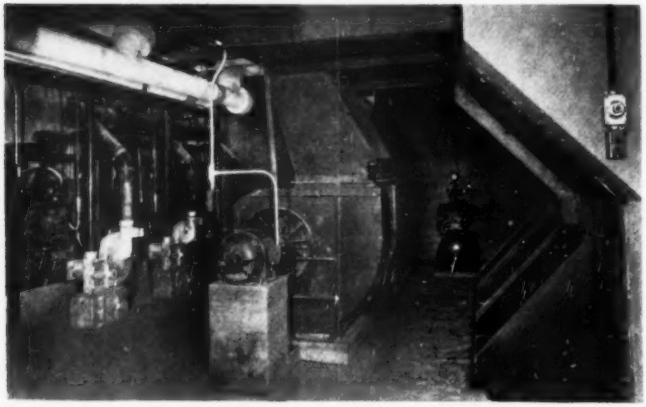
A third suggestion bridged the two major schemes of generating or purchasing power. This suggestion called for two 25,000-lb-per-hr 600-psi boilers, coupled with bleeder turbines for partial power generation.

The thinking for a power service setup built around purchased power dictated a choice between steam generation at process pressure level, 125 psi, or at a somewhat higher pressure, 235 psi. With the 125-psi arrangement a highly flexible steam source could be

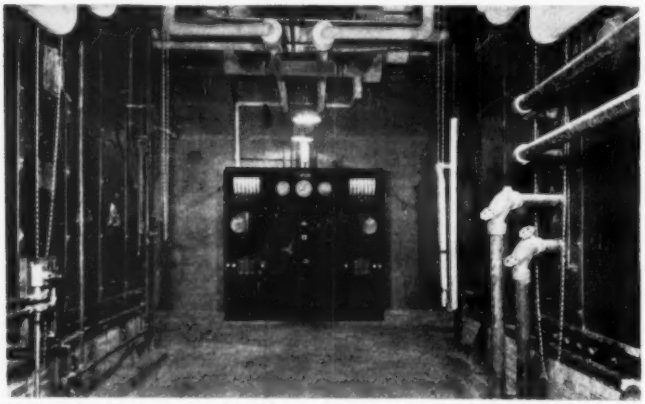
REPRESENTATIVE PLANT EQUIPMENT . . .



4 Raw water serves as makeup. It passes through a heat exchanger to a deaerator and hot-process lime-soda softener, through filters to boiler feed pumps (above)



5 Dual-drive (motor and turbine) forced-draft fan supplies combustion air. Radial-vane fan (left) takes hot gas from furnace to transport coal to spreader stoker



6 View between two spreader-stoker-fired boilers shows the control panel for both in the center. On the right is the admission piping for recirculated cinders

had with three package-type oil-fired units. As an alternate, two 25,000-lb-per-hr coal-fired watertube boilers could be employed. Both seemed highly attractive from an over-all cost basis.

But because steam load varied so widely and pressure fluctuations at process level might prove severe, it was felt that a better choice would be steam generation in 40,000-lb-per-hr units at 235 psi, coupled with pressure reducing stations for process and heating service. And this choice proved to be the one around which the power plant, Fig. 2, was built.

Steam Cycle. Two 40,000-lb-per-hr, pneumatic, spreader-stoker-fired units, Fig. 3, deliver steam at 235 psi, saturated to a main header. Here, Fig. 7, the steam passes through two 235-to-125-psi pressure-reducing stations for distribution to (1) power plant and process auxiliary drives (2) additional pressure-reducing stations for plant heating (3) process requirements.

Exhaust from steam-driven plant auxiliary drives joins with the output from the 125-to-15-psi pressure-reducing station to carry the plant heating load and low-pressure process requirements. Some condensate from the plant heating cycle and process heaters, as well as various miscellaneous sources, amounts to about 55% of the total water needs for the steaming units in the winter, and much less in the summer. This condensate return reenters the boiler-water cycle at a 6250-gal deaerating heater, Fig. 7.

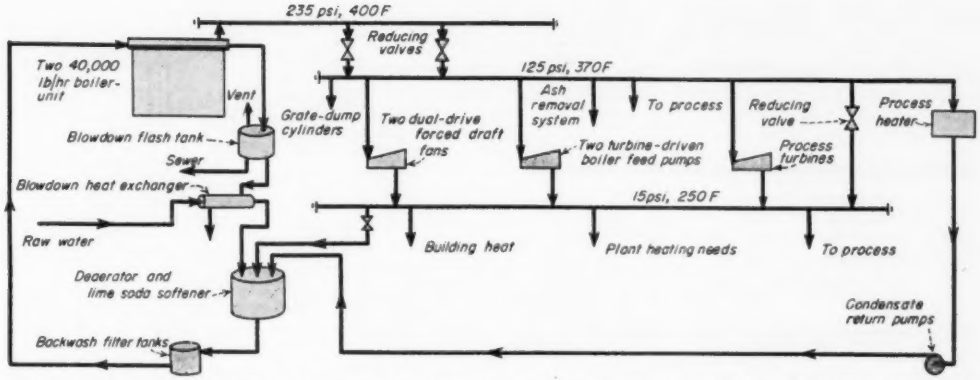
Raw water drawn from Lake Erie constitutes the makeup water. But before it enters the boiler cycle above, it undergoes considerable conditioning.

First it has its temperature raised in a heat exchanger through which the continuous blowdown reaches the sewer. The heated makeup water falls into a combined deaerator and hot-process lime-soda softener supplemented by sodium aluminate. From here it goes through two backwash filter tanks.

Boiler feed pumps, Fig. 4, pull water out of the filter tanks and deliver it to the two 40,000-lb-per-hr steam generators to complete the boiler-water cycle. A chemical-proportioning pump introduces phosphate at the boiler drum for final water-conditioning.

Boiler Units. One of the major considerations in the early boiler-selection period was the question of fuel-availability and fuel-flexibility for these new steam generators. When the choice had been made for coal-fired units a further decision had to be made on firing method. For the capacity of the units in question spreader stokers seemed to hold out favorable advantages from a fuel-flexibility standpoint.

The selection, a pneumatic design of



7 Simplified plant flow diagram follows steam from boilers at 235 psi through reducing valves to one distribution header at 125 psi. It supplies steam equipment at this level; through another reducing valve it meets lower-pressure needs

spreader stoker, operates as follows. A feeding mechanism, a worm in this case, takes coal, previously crushed, from a 150-ton storage bin. Along the worm travel is a sizing section to break up lumps of coal too large for transportation by pneumatic means. From the worm feed the coal enters a transfer housing where it meets a stream of hot gas 600 F, pulled from the furnace itself, Fig. 3. A radial-vane fan, Fig. 5, receives this hot gas and gives it a velocity high enough to transport coal through spreader nozzles for distribution over the fire bed.

The spreader nozzles are wedge shaped. Front and back distribution can be regulated by elevating or depressing the nozzle tips. Movable wedge blocks at the tip afford a means of changing side distribution.

A separate low-pressure fan supplies combustion air.

The coal itself comes into the plant by rail. It is dumped onto a track hopper, crushed and moved from there to storage, Fig. 2, or by means of a coal elevator to either of two 150-ton coal-storage bins. From these bins it travels by worm feed to the spreader stokers as described above.

Ash Removal. A steam-produced vacuum ash-removal system operates on both flyash and furnace ash. Furnace ash is hoed out and dumped on grid-hoppers. These hoppers prevent oversize ash pieces plugging up the ash-conveyor lines.

All ash up to 5-ton-per-hr capacity that falls into the suction line moves along for disposal to a 2000-cu-ft ash-storage tank. Material built up in the flyash collectors, located between the furnace gas outlet and the induced-draft fans, enters the ash-conveyor piping through a Y-fitting. The mixture of furnace and flyash dumps into the ash-storage tank.

PRINCIPAL NEW POWER SERVICE EQUIPMENT

Vinyl Resin Plant of Glenn L Martin Co, Painesville, Ohio

STEAM GENERATION AND AUXILIARIES:

Boilers, 2, 40,000 lb per hr, 235 psi, stoker fired	Babcock & Wilcox Co
Stokers, 2, Pneumatic spreaders, 3 tons per hr	Iron Fireman Mfg Co
Combustion control, 2, air operated	Hagan Corp
Blowdown, continuous, 2	Cochrane Corp
Blowdown heat exchanger	Cochrane Corp
Fans, forced draft, 2	Buffalo Forge Co
Breeching	Flyash Arrester Corp
Flyash-collection system	Flyash Arrester Corp
Valves, pressure-reducing stations, Two, 235 to 125 psi; one, 125 to 15 psi	Foxboro Co
Controllers, pressure-reducing stations	Mason-Neilan Regulator Co
Blowers, soot	Diamond Power Spec Corp
Water columns	Reliance Gauge Co
Safety valves	Manning, Maxwell & Moore Inc
Insulation	Philip Carey Co
Meters and instruments	Hays Corp; Foxboro Co

COAL AND ASH HANDLING:

Crusher, 1, 50 ton per hr, output 1¼x0 coal size	American Pulverizer Co
Elevator, bucket, 1	Fairfield Engrg Co
Belt conveyors	Pioneer Rubber Mills
Bunkers, coal storage, 2	Blaw-Knox Co
150-ton capacity, concrete, moisture-drain holes	
Cinder-collection system	Iron Fireman Mfg Co
Ash-removal system	Chicago Fire Brick Co

PUMPS AND COMPRESSORS:

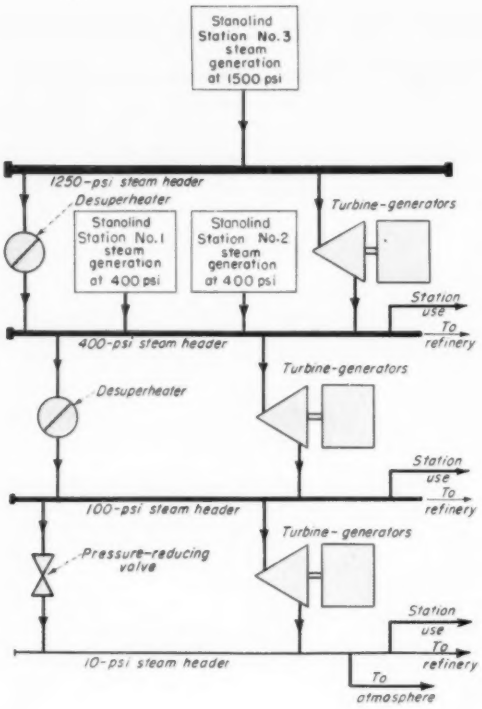
Compressors, 2, plant process service	Ingersoll-Rand Co
Compressor, 1, power-plant instruments	Ingersoll-Rand Co
Compressors, 3, process refrigeration	Worthington P & M Corp
Pumps, boiler feed, 3, One motor-driven, two DeLaval turbine drives	DeLaval Steam Turbine Co
Control, feedwater, Copes system	Northern Equipment Co
Pumps, raw water, booster	Worthington P & M Corp
Pumps, condensate return	Aurora Pump Co

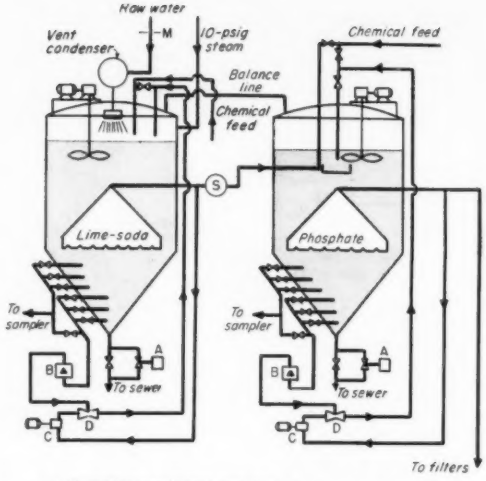
WATER TREATMENT:

Softener, hot process, 1, 90,000 lb per hr, 5000 gph raw water	Cochrane Corp
Deaerator, 1, 6250 gal, 7½ min total storage	Cochrane Corp
Filters, 2, Pressure type, 4-ft 6-in. tanks, backwash	Cochrane Corp
Drum treatment, Phosphate fed by proportioning pump	National Aluminate Corp

HEATING EQUIPMENT:

Unit heaters, various sizes (wall mounted, suspended	L J Wing Mfg Co; Trane Co
Convectors	Vulcan Soot Blower Corp
Consulting engineers	Blaw-Knox Co





A - Proportioning automatic desludger
B - Rotometers
C - Clear-water pumps
D - Eductors

1 Partly treated water from each lime-soda softener flows to its companion phosphate tank. Both recirculate sludge

2 Steam and power cycle shows arrangement of pressure levels and interconnecting turbine and desuperheating stations

Stanolind No. 3 Uses Hot Process on 100% Makeup for 1500-Psi Boilers

Operating experience and laboratory tests on a pilot boiler paved the way for applying hot-process feedwater treatment to these high-pressure dual-circulation boilers*. Results to date have been up to engineering department's expectations

By **GLENN R HULL**, *General Foreman*
Utilities and Conservation Division
The Whiting Refinery
Standard Oil Co (Indiana)

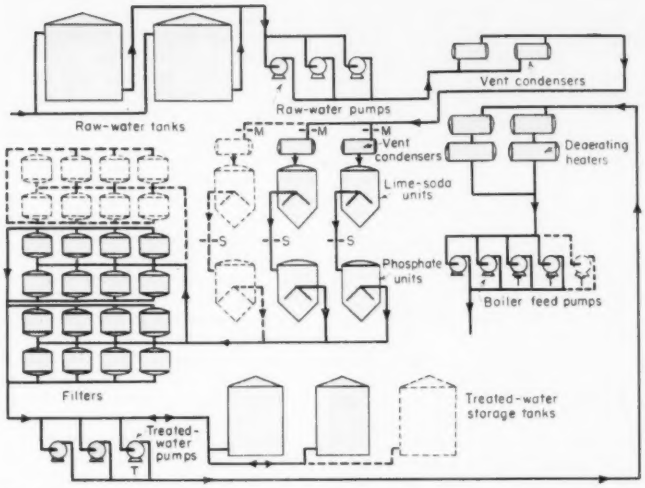
► STEAM AND POWER at the Whiting, Indiana refinery of the Standard Oil Company are generated in three plants, known as Stanolind Stations No. 1, 2 and 3. Boilers in No. 1 and 2 generate steam at 400 psig. and in No. 3 at about 1400 psig. Fig. 2 shows the refinery steam and power cycle. Water treated for all three stations is preheated in waste-heat exchangers located in various parts of the refinery. Makeup is 100% and comes from nearby Lake Michigan.

Lime–Soda–Aluminate. Station No. 1 uses a hot lime-soda-aluminate system with internal phosphate treatment. Equipment operates at atmospheric pressure. Station No. 2 uses a hot lime-soda-aluminate system, but phosphate is added externally and the system operates at about 240 F and 10 psig. Laboratory tests and experience gained with the latter system proved it could be used at Station No. 3.

An investigation, plus reports of field experience, indicated that water of sufficiently low silica content could be produced by using magnesium oxide or dolomitic lime. Other methods of feedwater treatment, including deionization, were considered but the evidence favored lime-soda-phosphate for the existing conditions. At that time, a zeolite able to withstand temperatures of 180 F was not available.

Method at 1500-Psi Plant. System at Station No. 3 is illustrated in Fig. 3. Equipment shown in full lines has been installed, while that in dotted lines is either under construction or has

* Abstract of a paper presented at the Midwest Power Conference, April 18, 1949.



3 Raw water, after picking up heat from refinery heat exchangers, enters storage tanks. From here it is pumped through vent condensers on its way to softeners

TABLE SHOWING AVERAGE ANALYSES OF RAW AND TREATED WATER AT STATION NO. 3

	Raw water	*Primary softener effluent*	*Secondary softener effluent*	*Effluent from filters*	*Boiler water Primary section*	*Boiler water Secondary section*
Carbonate alkalinity (as $CaCO_3$), ppm	——	26[1]	55[1]	55[1]	45	110
Hydrate alkalinity (as $CaCO_3$), ppm	——	22	9	9	100	325
Calcium (as $CaCO_3$), ppm	88	5[2]	1[2]	0.5[2]	——	——
Magnesium (as $CaCO_3$), ppm	44	0.6	0.0	0.0	——	——
Soap hardness (as $CaCO_3$), ppm	120	10[3]	0.0	0.0	——	——
Phosphates (as PO_4), ppm	——	——	14	14	29	90
Silica (as SiO_2), ppm	5	0.8	0.8	0.8	1.8	5.3
Chlorides (as NaCl), ppm	12	12	12	12	25	80
TDS (by evaporation), ppm	155	140	155	155	315	1000
pH value	7.9	10.6	10.55	10.50	11.4	11.8
Turbidity	——	5	3	1	Clear	Clear

[1]Excess alkalinity
[2]Reliability of this determination is questionable.
[3]Soap hardness is usually not in agreement with sum of Ca plus Mg values.

been authorized. Raw water, after picking up heat from refinery waste-heat exchangers, enters the raw-water storage tanks. After passing through vent condensers, the water is discharged into the lime-soda softeners.

Line to each lime-soda softener contains an orifice for a recording meter. The meters send out impulses for chemical proportioning. The partly treated water leaves the lime-soda softeners and enters the phosphate units through lines that contain Sparling meters. These meters also impart electrical impulses for chemical proportioning. After receiving phosphate treatment, the water enters the filter header. From here it flows through anthracite filters in parallel and collects in the filtered water header from which the treated-water pumps take suction. Also connected to the filter outlet header are the treated-water storage tanks. In emergency the treated-water pumps can take suction from these tanks. From the treated-water pumps the water goes through deaerating heaters to the feed pumps and into the boilers.

Operate in Pairs. Through each lime-soda softener, water flows only to its corresponding phosphate unit, Fig. 3. Each tank has sludge recirculators. Raw water flows to the lime-soda softener through the orifice of a proportioning meter, the softener vent condenser and spray head. Softener steam comes from the refinery 10-psig system, and steam spaces of the softeners are connected by an equalizing line. Softeners are equipped with variable speed agitators set off center. The lime-soda treating chemicals are introduced just above the water level inside the periphery of the agitator paddles.

Sludge may be recirculated through the chemical line or through an adjacent line. Effluent from the lime-soda softener enters the phosphate tank at its center above the inner cone and below the water level. Treating chemical enters the water-inlet line at tank center.

Sludge Recirculation. Conical bottoms of the softeners are designed with a 70-degree included angle to facilitate sludge removal. Of six sludge lines, top three serve as samplers for sludge-level control, while any one of the bottom three can be used for recirculation. Sampling can be done at these points also. Sludge is recirculated by the clear-water pumps and eductors. The pumps take suction on the softener effluent lines and discharge through the eductors into the tops of the softeners. Sludge to be recirculated passes through a rotometer and is pulled into the recirculating line by the eductor. Emergency desludging can be done by a hand-operated valve. Normal desludging is done with a proportioning desludging valve located on a bypass around the emergency hand-desludging valve. Rated capacity per softener (or per pair) is 80,000 gal per hr with a retention time of 1½ hr.

Filter Setup. Sixteen filters are now in operation. Final plan is to have 24 filters for three pairs of softeners. The filters set four in a row, two rows constituting a bank with walkway, or aisle, between the two rows of each bank. Piping and control mechanisms face these walkways, and so each walkway provides access to the controls of eight filters. Each filter is equipped with an inlet and outlet pressure gage and an indicating flowmeter. Each filter aisle has an indicating flowmeter on the backwash line, the meter being visible from the backwash-control valve for all filters in that bank. Backwash pumps are located in the treating room. Filtered water is used for backwashing, and backwash discharge can be returned to any phosphate softener.

Chemicals. Hydrated lime is purchased to contain not less than 96.5% calcium hydrate, not more than 1.28%

silica, and not more than 23.5% water of hydration. When operation of the treating equipment was started, the entire lime demand was met by the hydrate. But dolomitic lime was added after a few days; the hydrate lime charge, of course, was decreased accordingly. Silica content of the primary softener effluent was checked as the amount of dolomitic lime was increased. A charging ratio of about 1 lb of hydrated lime to 12 lb of dolomitic lime appears to be satisfactory.

The dolomitic lime used contains 62.9% calcium hydroxide and 33.8% magnesium oxide. It is charged into the lime-soda mixing tanks with the soda ash and sodium aluminate. The soda ash purchased is "light," containing 58% sodium oxide. Enough is used per batch in the mixing tanks to give the desired carbonate excess in the primary softener effluent.

Anhydrous disodium phosphate is used for secondary softening. It is dissolved in rectangular tanks equipped with pumps and solution proportioners. The sodium aluminate used is Nalco No. 680. Sludge in the lime-soda softener was too finely divided and stayed in suspension longer without the use of sodium aluminate.

ORGANIC TREATMENT

An organic retardant containing antifoam material is introduced into the water at the outlets of the deaerating sections of the heaters. This point was chosen to take advantage of the oxygen-scavenging property of the organic. Its feed is proportioned by the flow of water to the deaerating heaters. It is an aid in keeping piping and feedwater regulating valves free from deposits. This material also conditions and keeps in suspension any sludge that might form in the boiler water. The antifoam agent reduces foaming, which aids in the control of boiler-water level. It also tends to reduce carryover in the steam entering the superheaters. Organic treatment also coats the boiler and tube surfaces which should aid in corrosion control. Material for an organic-polyphosphate threshold treatment is fed into the suction side of all raw-water pumps that discharge through heat exchangers. Solution-type feed is used for both the retardant and threshold treatments.

Chemical Control. Each primary and secondary softener has two sampling points. One is located at a point in the body of water in the tank where there is a theoretical retention of one-half hour at rated capacity. The other is in the effluent pipe. Filtered water header also has a sampling point. Water from these points is drawn off continuously through sample coolers in the control room. The half-hour retention samples were found to be of little value in control, so they are ignored. A pH recorder, located on the water-treating control panel, can have its cell connected to any of the continuously cooled samples.

Test Records. The water treater is required to make a control analysis of each softener effluent once an hour. His analysis, together with any changes in control settings, is then recorded on the log sheet. Control analyses and changes in settings are made oftener than once per hour when needed, but these are not necessarily logged. Every four hours the treater analyzes the filtered water.

Tests made on the primary and secondary softener effluents are the phenolphthalein endpoint or P reading, the methyl orange or M reading, and the soap hardness or H reading. From these the treater calculates the hydrate excess or $2P—M$, and the carbonate excess or $2(M—P) —H$. These calculated results are also recorded hourly. On the secondary softener effluent an hourly colorimetric test is made for phosphate excess, the result being recorded as PO_4. In addition to the tests described above, the treaters run a P-barium chloride test and a total-dissolved-solids test on each boiler's water once an hour. The TDS test is run on a conductivity indicator.

Results of these tests are used by the boiler-room engineer for control of blowdown. Composite 3-gal samples from the continuous sample lines on all softener effluents and on the filtered water are drawn off for each operating shift for use as a check on the operation and treating performance.

Laboratory Control. The utilities division maintains its own laboratory where the shift samples are analyzed. In addition, analyses of boiler water are made. A daily calibration is made on the pH recorder. The water treaters' testing equipment is kept in calibration and their testing supplies maintained by the laboratory. Testing technique of the treaters is a responsibility of the laboratory personnel. The chemical engineer in charge makes a daily comparison of laboratory findings, operating tests, and performance of the treating equipment. Any corrective steps indicated are put into effect through the supervisory personnel of the operating department.

Silica Content. Table shows the average analyses of the water resulting from the treatment. Deviations from these values are very slight. It will be noted that what might be considered relatively high alkalinities for 1500-psig boilers result from this treatment. In spite of the high alkalinity, also present in all 400-psig boilers in the refinery, no ill effects or disability has ever been experienced from it. Carryover has been low, less than 1 ppm in the condensed steam. Sampling and running analyses for silica content of condensed steam are extremely difficult to obtain, but a few have been run. Results indicate a silica content in condensed steam of between 0.008 and 0.025 ppm.

Boiler Design. Boilers at Station No. 3 are the dual-circulation type; steam produced in the secondary section of these boilers is condensed and does not leave them (POWER, March and April 1948, and February 1949). All steam that does leave the boilers is produced in the primary section where the boiler-water concentration (including the silica concentration) is comparatively low. Boiler design is partly responsible for the low silica content of the steam. Two other factors responsible for this are the high pH of the boiler water and the low silica content of the feedwater, both of which are results of the treatment. This is believed to be the first application of this treating method for 1500-psig boilers using 100% makeup. While no unique or unusual features were incorporated, very close attention was given to its detailed design.

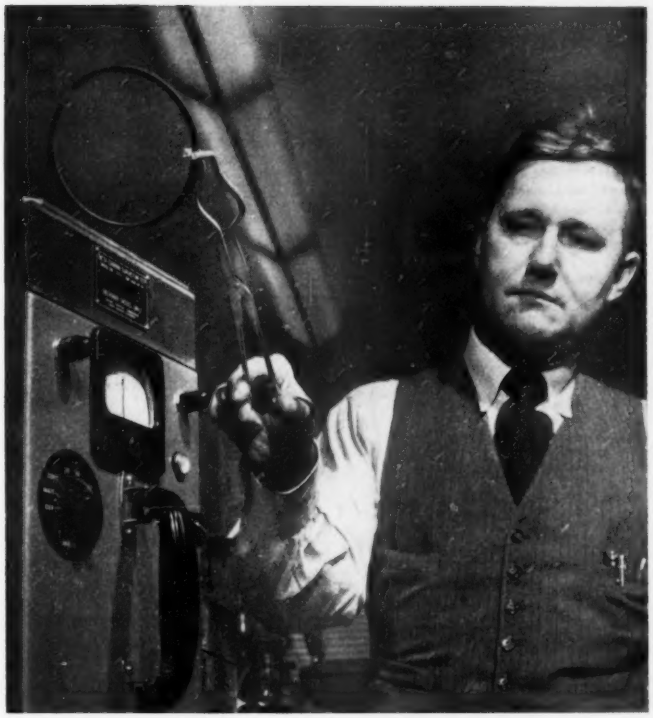
OPERATING RESULTS

The first boiler was fired in May 1948, and the second in August 1948. There have been no tube failures due to water conditioning. In March 1949, after a period of about six months' uninterrupted operation, both boilers were shut down for general inspection and repair. A visual inspection of those parts that were accessible indicated no evidence of corrosion or scale. Time did not permit turbining waterwall tubes in the radiant section, but a few tubes in the convection section were turbined and found clean.

In spite of the fact that the table indicates zero magnesium in the feedwater, a comparatively small amount of magnesium phosphate was found in the main steam drum, the downcomer section, and lower waterwall headers.

In an attempt to eliminate magnesium phosphate in the boiler even more completely, the amount of dolomitic lime fed to the primary softeners has been reduced. This has resulted in a slightly higher silica content of the feedwater but, even so, results indicate the silica content of the boiler water is well below the maximum allowable.

Results to date indicate the hot lime-soda-phosphate treatment will produce a feedwater satisfactory for 1500-psig boilers of the dual-circulation type, using 100% makeup that is taken from Lake Michigan.



"HOT" RING, made radioactive by exposure to an atomic pile, is tested with Geiger counter before placing in engine

Test Radioactive Rings

► CAPABLE OF MEASURING WEAR in amounts as small as one-millionth of an ounce of lost metal, nuclear methods in use by California Research Corp promise to speed development of improved fuels and lubricants.

In its Richmond, Calif. labs, this company, research organization for Standard Oil Co of Calif., uses radioactive parts in its engine-testing program. Because of the sensitive indications these give, fuel and lubricant tests can be run in a much shorter time than conventional methods permit. The new method was developed in close collaboration with the Atomic Energy Commission and the parts are activated in an atomic pile at Oak Ridge National Laboratory.

Typical Test. A radioactive piston ring, for example, is taken from its 300-lb lead safety box and, after its "hotness" is checked, is placed carefully on a test-engine piston. After several hours' operation, a researcher takes a sample of oil from the engine's crankcase. A delicate Geiger counter tests this oil and immediately indicates the amount of metal worn from the activated ring—minute particles of iron flushed away by the lubricating oil. In addition to speeding such testing, the new method permits measuring wear selectively—of a particular ring or other engine part.

The oil industry now uses radioactive substances in two other ways: One involves tracing oil shipments through miles of pipeline by following with Geiger counters the progress of an oil sample containing one-billionth of an ounce of radioactive barium. This makes it possible to separate more accurately the many types of crude oil and products that flow one behind another through a given pipeline.

In another application, radioactive carbon is employed in much the same fashion to learn more about what happens to hydrocarbon molecules as they pass through the complex steps in the operation of a modern oil refinery.

It is expected that this new scientific tool will contribute to steady improvement of production methods and of petroleum products themselves, and to the more efficient use of the nation's oil resources.

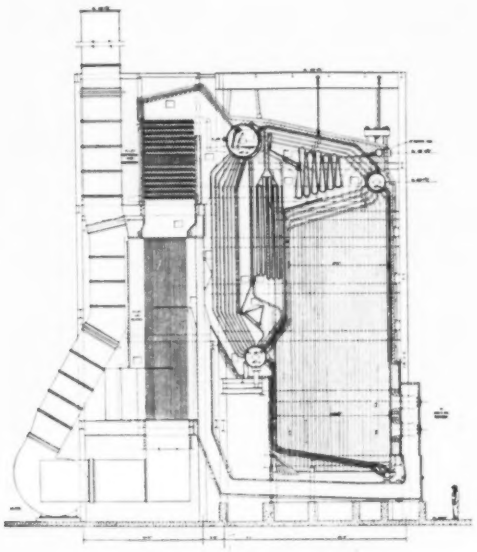
ENGINE WEAR is measured by testing lube oil from engine for radioactivity, indicating amount of metal lost by ring

All of these Public Utilities have recently ordered Riley Steam Generating Units

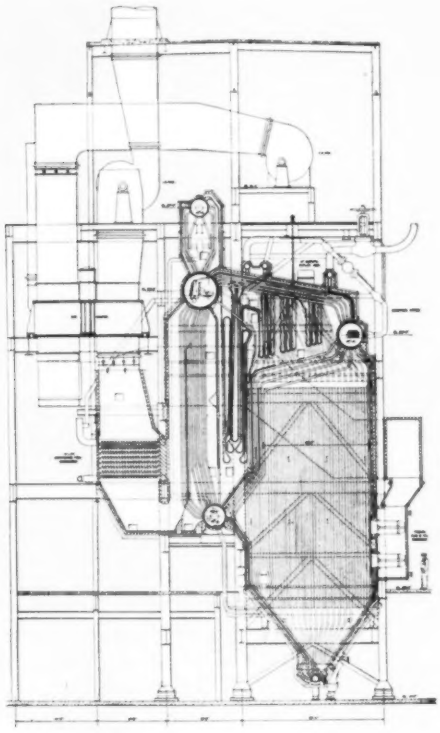
Houston Lighting & Power Co.
Public Service Co. of Indiana
Arkansas Power & Light Co.
New England Power Association
Northern Virginia Power Co.
Utah Power & Light Co.
Central Illinois Light Co.
Carolina Power & Light Co.
Union Electric Co. of Mo. & Ill.
Southwestern Public Service Co.
New Orleans Public Service Co.
Interstate Power Co.
Otter Tail Power Co.
Central Ohio Light & Power Co.
Lynn Gas & Electric Co.
Northwestern Public Service Co.
Southern Ind. Gas & Electric Co.
Pennsylvania Edison Co.
Iowa-Illinois Gas & Electric Co.
West Penn Power Co.
Ohio Edison Co.
South Carolina Power Co.
Mississippi Power Co.
Gulf Power Co.
Upper Mich. Power & Light Co.
North Dakota Power & Light Co.

The SWING in the

There is a very noticeable swing among Public Utilities to Riley Steam Generating Equipment. More and more Public Utility Companies are making their initial installation of Riley equipment and those companies who have tried Riley equipment are, almost invariably, coming back for more Riley units when expanding capacity. More than 70% of Riley's total sales during the past few years has been to public utility companies. Riley has installed or on order over 30,000,000 lbs. of steam capacity in public utility plants.



HOUSTON LIGHTING & POWER CO., Houston, Texas
850,000 lbs. /hr. 1025 lbs. 905°F.
Houston Lighting & Power Company has installed or on order 9 Riley Units
4,590,000 lbs./hr. capacity of Riley Units



CITY OF LOS ANGELES—HARBOR STEAM STATION
825,000 lbs. hr. 1200 lbs. 900°F.
There are five Riley Steam Generating Units in this Plant
3,825,000 lbs. hr. capacity of Riley Units

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RILEY

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Cincinnati Atlanta New Orleans Memphis St. Louis Kansas City St. Paul Tulsa Houston
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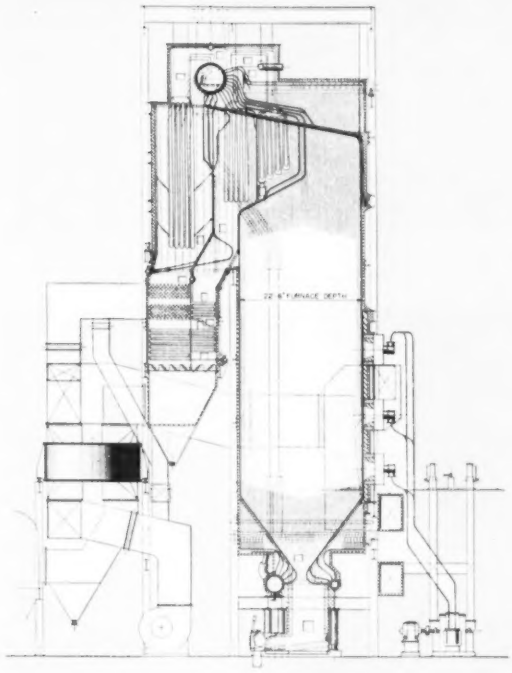
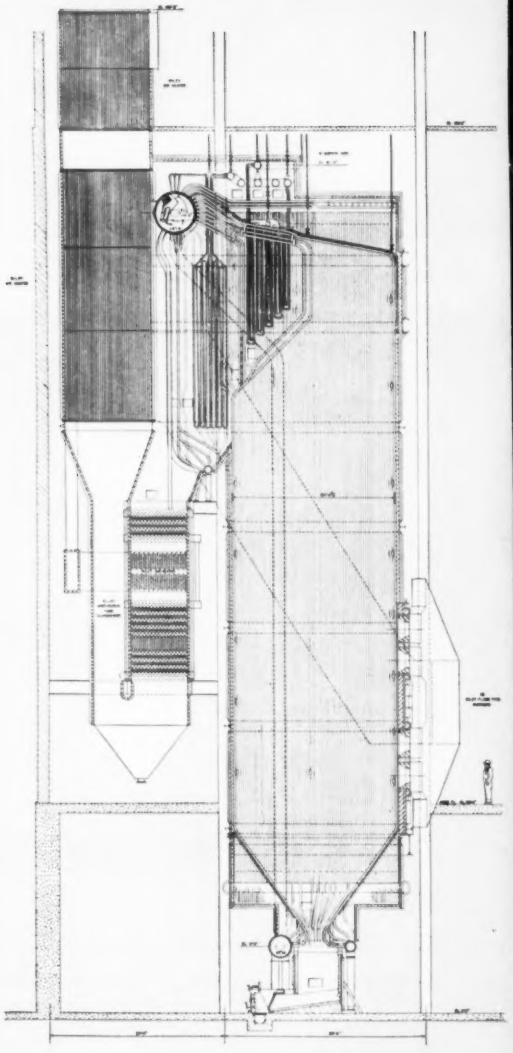
Central Station field is to RILEY





UTAH POWER AND LIGHT CO., Salt Lake City

620,000 lbs. hr. 1500 lbs. 955°F.
Utah Power and Light Co. is also installing
a 450,000 lbs. hr. 1050 lbs. 905 F. Riley
Steam Generating Unit fired by Riley
Pulverizers in one of their other plants
1,070,000 lbs. hr. capacity of Riley Units

CENTRAL ILLINOIS LIGHT CO., Peoria, Ill.

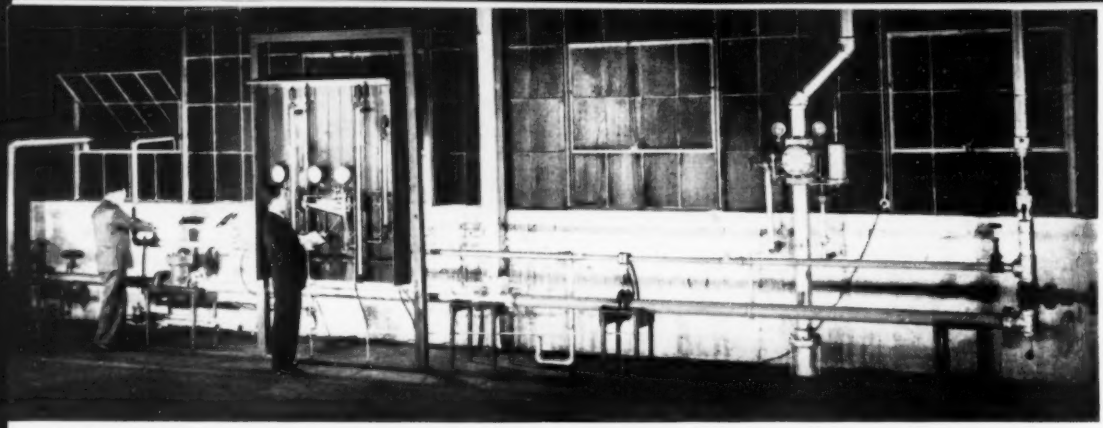
600,000 lbs. hr. 950 lbs. 900°F.
There are four additional Riley
Steam Generating Units in this plant
1,875,000 lbs. hr. capacity of Riley Units

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

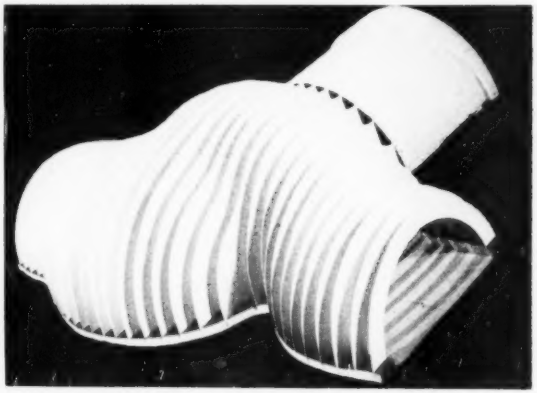
. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

ECONOMIZERS · WATER-COOLED FURNACES · STEEL-CLAD INSULATED SETTINGS · AIR HEATERS



1 **TEST SETUP** utilizes compressed air from plant system. Thin-plate orifices are used for metering. Air enters at extreme right in view above, flowing either through 1½-in. line for testing small valves or the 4-in. line for large valves

4 **PLASTER CASTS** preserve internal contours of models after flow study is complete. Here designer scales their dimensions



5 **PAPER TEMPLATES** are then developed, using stress analysis and practical experience to determine wall thickness, etc

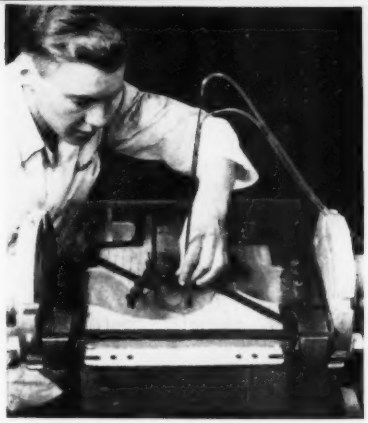
Flow Research Yields New Data on

Use of air at commercial pressures for test fluid makes experimental work on large valves practical. Setup used to determine pressure drops of existing designs and to study flow behavior of various internal contours for new constructions

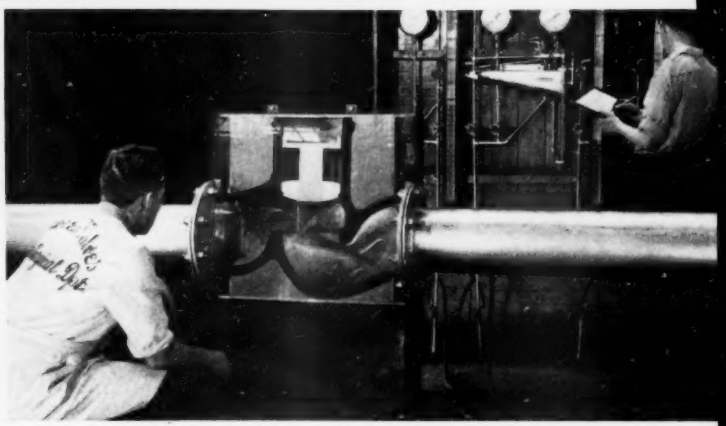
► RELIABLE INFORMATION on pressure drop through valves of various types and sizes, rare in the past, promises to be readily available in the future as new methods of testing make it possible and practical to measure flow characteristics of even large valves. Such data permit designers to develop more effective valves, and users to select them intelligently for various applications.

Pioneering steps in this direction have been taken by Edward Valves, Inc. Their investigations show that air at commercial pressures can be used as the testing fluid, making experimental work on large valves (up to 14-in. nominal size) practical and not prohibitively expensive. The first of the photos above indicates the test facilities used in their work. Compressed air comes from the plant system, which has a capacity of 4000 cfm of free air at 100 psi. Thin-plate orifices serve for metering, two orifice lines being provided. A 1½-in. line, with four orifice plates (3/16 to 1 in. inside diameter), handles valves up to 2-in. nominal size, while a 4-in. line with three orifice plates (1 to 3 in. inside dia) handles 2½-in. and larger valves. In the photo, air enters at extreme right, flowing either through the small orifice line, which appears above, or the large orifice line, below.

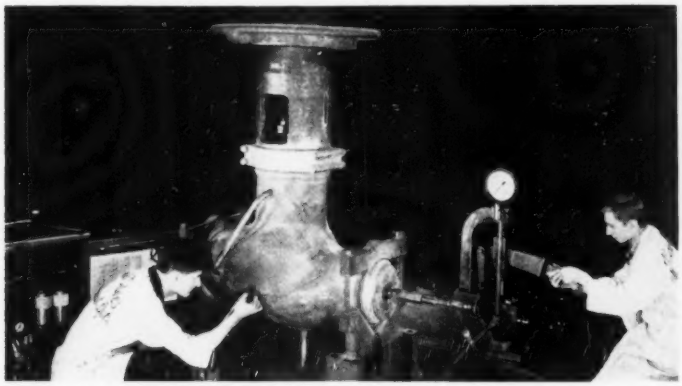
Metering Setup. Orifice plates, approaching and leaving piping, straight-



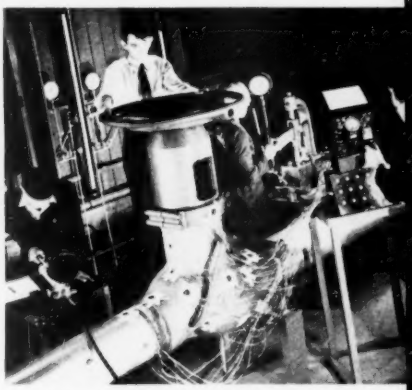
2 **PITOT TRAVERSE** of air flow through a half-model reveals effects of contours



3 **FLOW PATTERNS** are also disclosed by yarn streamers on pins stuck in the plastic half-model. Such testing shows where modifications of internal contours are needed



6 **STRESS-COAT TECHNIQUE** is used to check first casting of new design, being particularly suited to revealing quickly points where strengthening may be necessary



7 **STRAIN GAGES** in areas of high stress give accurate, final check on body design

Valve Pressure-Drop Characteristics

ening vanes, flanges and pressure taps are all constructed in accordance with ASME research publications on fluid meters. This permits direct use of coefficients from the tables in these reports. While coefficients vary slightly with Reynolds' number, use of a mean coefficient over the useful range of each orifice results in a maximum error of less than 1%.

Test valve can be seen at the left of the instrument panel. Pressure taps are in the adjacent pipe, one diameter upstream and three diameters downstream. Throttling valves, either upstream from the orifice or downstream from the test valve, control air flow.

Of the three well-type mercury manometers, one reads orifice pressure differential, a second reads valve pressure drop, and a third is available for pressure explorations within the test valve. Three bourdon gages show upstream pressure at orifice and at valve, and downstream pressure at the valve. An inclined oil gage calibrated in inches of water permits measuring small pressure drops across the test valve. There are thermometer wells upstream from orifices and valves.

Applications. One obvious application of these testing facilities is determining accurately the pressure-drop characteristics of existing valve designs. Of even greater significance is the testing of half-models of projected designs to determine best contours. This has led to a design procedure radically different from previous methods. Sequence of photos above illustrates the steps in testing and design.

To make the test results fully useful, a comprehensive analysis was carried out to develop equations that would properly account for all the variables involved. A special slide rule, which can be seen in one of the photos, was developed to speed the calculation of test results. With three fixed scales, three slides and a number of auxiliary scales for conversions, this device reduces calculation time to about 25% of that normally needed. Importance of

(*Continued on page* 110)

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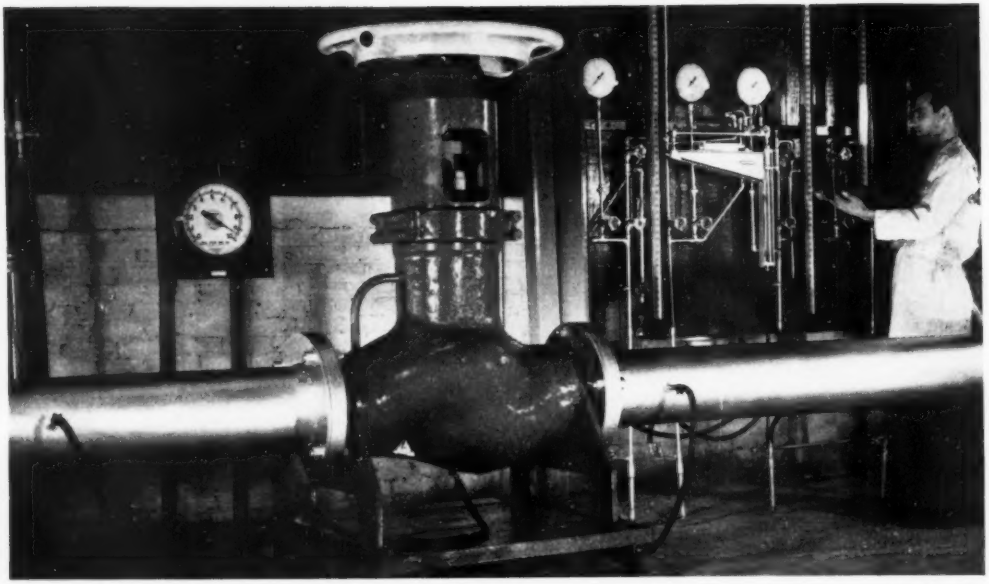


PRESSURE-DROP TEST of newly designed valve verifies flow characteristics indicated by original studies of half-models

this time saving can be realized from the fact that testing a single valve usually requires about 20 runs.

Parallel tests of some of the valves with water, conducted by the Armour Research Foundation of Illinois Institute of Technology, show close agreement, as do tests of valves in actual service on steam lines.

In work with new designs, a half box of steel plate with steel diaphragm and seat and a plexiglas cover is employed. This is mounted in the test stand as a regular valve would be, but half the piping at either end is sealed off. Plastic models of internal contours, to full scale, are tested in the box to determine flow characteristics and arrive at the best shape.

For this work, it is necessary to know more than over-all pressure drop. Only "seeing" the nature of the flow—where it is smooth, where it is turbulent—makes it possible to find out quickly what changes in internal shape are needed.

Flow Studies. Three distinct methods are followed: (1) Pins stuck into plastic model at various points carry yarn streamers that show direction and nature of flow. (2) Introducing "smoke" into the air stream at the proper points also makes it possible to see the pattern of flow. (3) Pitot-tube exploration shows velocities existing at various points inside the valve. Skillful application of the knowledge gained by these methods yields preliminary designs approximating the most efficient contours. Determination of the final contour results from comparative pressure-drop tests on the most promising preliminary designs.

Casting a plaster pattern in the final plastic mold gives the designer a convenient guide for his work. From this pattern he develops paper templates, using theoretical stress analysis and practical experience to determine wall thicknesses. Both internal and external contours undergo some slight changes to comply with sound pattern-making and foundry practices.

Thus experimental work forms the basis for design. After the pattern is made and the first casting produced, further experimental work verifies the design. Tests of the actual valve casting on the flow stand determine its over-all pressure-drop characteristics, which can then be compared with those of the model and those of previous valve designs. This work confirms the suitability of the internal contours. Stress determinations by two methods check the adequacy of the external shape and wall thicknesses and indicate areas needing strengthening.

Use of the stress-coat technique yields a reasonably accurate picture of stress conditions, being especially suited to revealing quickly areas that require additional strengthening. Exterior valve surfaces are painted with brittle material of known characteristics. When pressure is applied to the valve, hairline cracks develop in this coating. Width and number of cracks indicate magnitude of stress, while their position shows its direction.

Knowing from these results the location of stress concentrations and other points requiring special attention, final checking can be handled efficiently with more-accurate strain gages. As a result of stress measurements, valve shape may be altered slightly, and a new casting made. A similar series of tests verifies the flow and stress characteristics of the revised casting before the design is released to the shop for regular production.

Some Results. Flow research has revealed many new facts, and confirmed some ideas that formerly lacked experimental verification. For example, a conventionally designed 10-in. 1500-psi globe stop valve has a pressure-drop coefficient of 4.2. After extensive model tests, a practical shape was developed with a coefficient of 2.3. Since this coefficient is directly proportional to pressure drop for given flow conditions, this represents a reduction in pressure drop of 45%. The improvement is due to many factors. Position of the disk when open, space for laterally deflected fluid, and elimination of stagnant pockets of fluid are only a few. Comparable reductions in pressure drop through angle valves have also been obtained.

The Election of November 2, 1948 GAVE NO MANDATE FOR SOCIALISM

The President and those who support his legislative program have objected to the substance of my previous editorial, which appeared under this headline: "Now is the Time to FIGHT SOCIALISM in Washington."

In that editorial I explained how Washington is poised to follow the disastrous policy of forcing industry to skimp on new plants and new equipment. That policy landed Britain in the numbing embrace of the Socialists. I cited the experience of Britain to show how such skimping on industrial tools can bring a nation to economic stagnation . . . and Socialism.

The President, in his recent Jackson Day speech, brushed aside this warning . . . "They are again trying to frighten the people with the old worn-out bugaboo that Socialism is taking over in Washington." Senator Francis J. Myers of Pennsylvania asserted that I was guilty of "warfare against any reasonable effort to keep our system of free enterprise working."

These criticisms may be sincere. But they are not well-founded.

I want to show why they are not well-founded by basing this editorial on Washington rather than Britain.

In Washington the Administration has proposed a legislative program, the key parts of which would clearly put the country far on the road to Socialism. Let us see how.

There are two steps in the process:

FIRST: The government by its taxation program undermines private industry so that it cannot provide itself with the necessary new plant and tools.

SECOND: The government itself steps in to provide the plants and equipment that it has blocked industry from getting. *That is Socialism.*

Here is how Washington is promoting Socialization of the steel industry—and of other industries.

Steel has been expanding its capacity and improving its equipment chiefly by plowing back its profits. During the last three years it has spent $1.4 billion for new plants and new tools. That was more than the companies had available from their own earnings. But profits provided more

continued on next page

than half of that money – more than $700 million. The remainder came from loans and from depreciation reserves set aside out of the earnings to replace worn-out equipment.

Profits must continue to provide the funds needed to pay for the bulk of the steel industry's necessary expansion. That is because private citizens, their income slashed by heavy taxes, have not been willing to buy steel stocks even at prices ruinously low for the companies and their present stockholders. The stock market currently prices the mills and other facilities of the nation's principal steel-producing companies at far less than fifty percent of the cost of reproducing them.

Let us take another example. Profits are essential to expansion in the electric light and power industry also. This year private companies are planning to buy $2 billion worth of new plant and equipment. To do that without going overboard in debt, they must sell to the public some $300 million worth of common stock. A squeeze on their profits would make that sale virtually impossible.

For tens of thousands of small business enterprises profits afford virtually the only practical source of funds for new equipment and expansion.

In the face of these and many other examples that might be cited, what is the most effective way to prevent industry from re-equipping itself and expanding is capacity to meet our essential needs?

Obviously, it is to cut down profits. And that is what the Administration is trying to do. The President has declared that steel prices are too high, and is demanding that Congress raise taxes sharply on all corporations.

There you have the first step toward socializing industry.

Next comes step two. Have the government supply the tools and equipment which, by taxation, it prevents industry from getting.

The Administration has proposed legislation to carry out this second step. It is called the "Economic Stability Act of 1949," for short, the "Spence Bill."

This bill gives the President the power to provide industrial facilities – in steel, power or any other industry – where he finds that a shortage is hampering or is likely to hamper the economy.

True, the bill says that the government is not to construct new plants if private companies will do it through government loans, on terms prescribed by the President. That may be just one step short of complete socialization. But it is only a short step. And the Spence Bill authorizes the government to take that step.

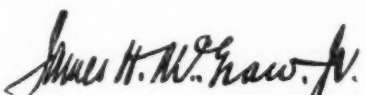
By itself, the Administration's "Stability Act" sounds harmless enough. It would have the government build plants only as a last resort. But it provides also that if private enterprise cannot turn out all the goods the country needs, the government can and should step in and provide the equipment to do it.

Now, take that power together with an Administration tax program that undercuts the ability of private enterprise to supply the new plants and equipment it needs out of its own earnings. That combination promotes government ownership and operation of industry.

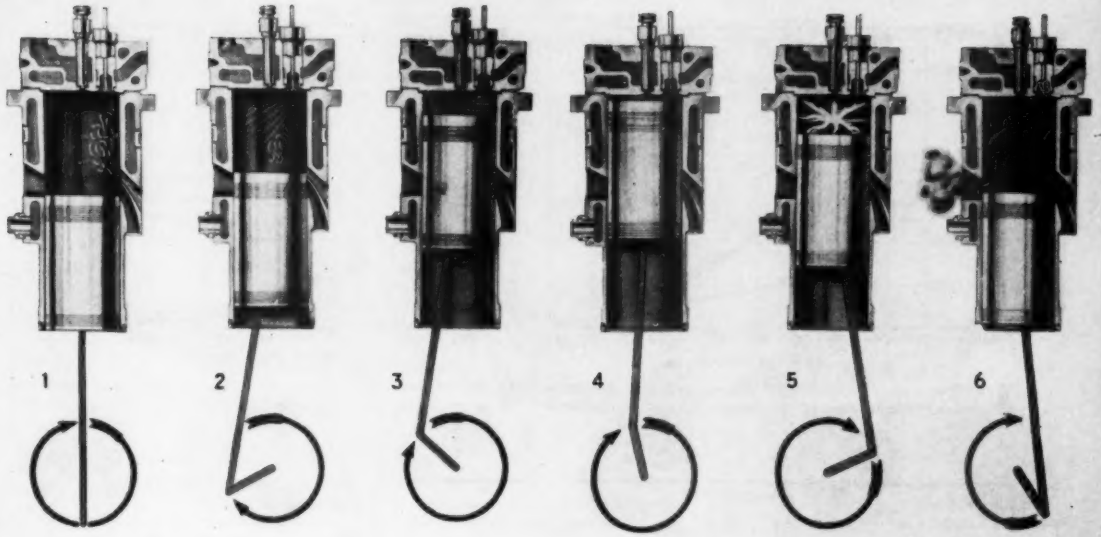
And that is Socialism.

The American people, of course, have the right to live under any system they choose—Capitalism, Socialism, Fascism, Communism, or what-have-you. But before Socialism or any other "ism" is imposed upon us from above, the people should know the facts. If this editorial shall have contributed in some small degree to that end it will have served its purpose.

The election of November 2, 1948 gave no mandate for Socialism.



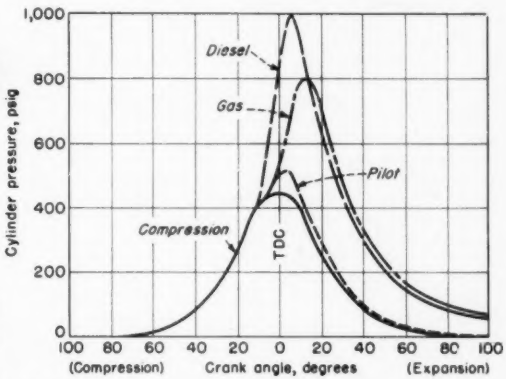
President, McGraw-Hill Publishing Company, Inc.



1 Steps in 2-cycle dual-fuel operation: Air enters (1); as exhaust port closes, gas is admitted (2); gas and air are compressed (3); pilot oil is injected and ignites (4); burning oil fires gas, which expands (5); exhaust ports open (6)

Developing 2-Cycle Dual-Fuel Engines

In applying the automatic-conversion dual-fuel principle to 2-cycle diesels, tests disclosed useful data on the combustion characteristics and the basic factors controlling performance

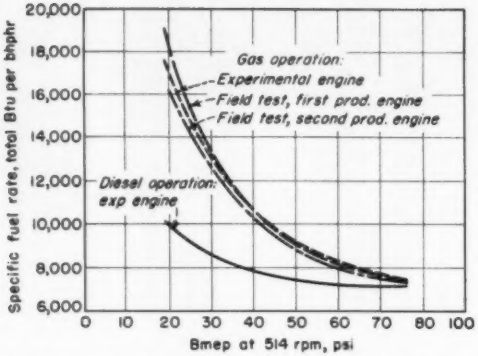


2 Comparative indicator diagrams for compression alone, and operation on pilot oil only, on gas, and full diesel cycle

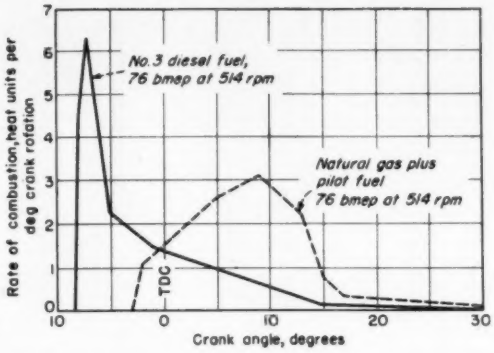
► THE 4-CYCLE DUAL-FUEL ENGINE burns either oil or gas, or a combination, operates at diesel compression pressures, and converts instantaneously under load from one fuel to the other. While it is now widely used, its 2-cycle counterpart has had relatively less attention. Furthermore, much remains to be learned about the combustion and other basic characteristics of both types when on the gas cycle. Thus considerable interest attaches to reports of development work on 2-cycle dual-fuel engines and of investigations into the fundamental nature of operation on gas.

Such a report was presented by E L Conn, R H Beadle and G A Schauer, all of Fairbanks, Morse & Co, Beloit, Wis., at the 21st National Oil and Gas Power Conference sponsored by the Oil and Gas Power Division, ASME. Their paper, "The 2-Cycle Dual-Fuel Diesel Engine with Automatic Fuel Conversion," was one of eight on various phases of internal-combusion-engine application programmed at this meeting. (See end of this article for list of papers.)

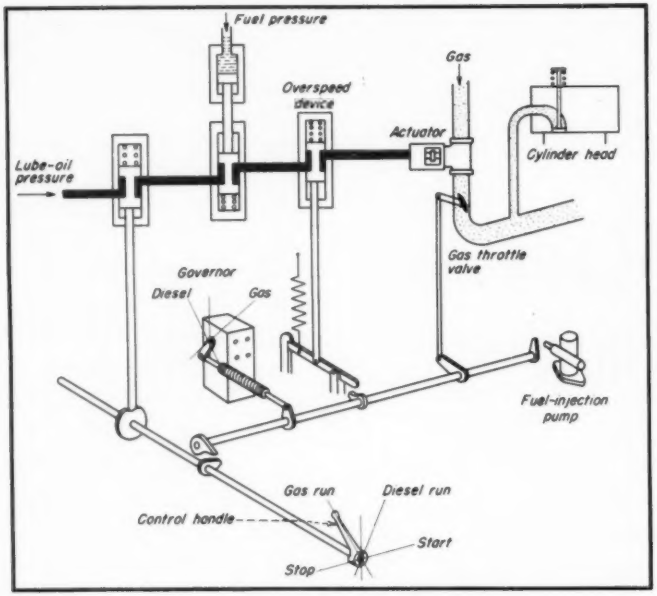
Basic Cycle. To explain simply the basic dual-fuel cycle, pictured in Fig. 1, the authors assume that it is desired to run a conventional 8-cylinder 2-cycle diesel on gas, as a lab experiment. With the engine at rated speed, cutting off fuel supply to one cylinder would produce an indicator diagram for that cylinder like the lower curve of Fig. 2, with peak pressure under 500 psi. Bringing the injection pump back into operation and increasing fuel until the cylinder is loaded to 70 bmep yields a normal diesel-cycle diagram with a peak



4 Performance of experimental engine and first production units. Note typical high gas consumption at partial loads



5 Slower burning rate and lower maximum pressure when operating on gas show why such operation is noticeably quieter



3 Diagram shows control system for governing on oil or gas, automatic conversion from one fuel to the other, and protection against unsafe operating conditions

pressure of approximately 1000 psi.

Now if fuel delivery is cut to about 10% of that needed to develop 70-psi bmep, the result is the curve in Fig. 2 labeled "pilot," with peak pressure only a little over the compression pressure. To burn gas in this engine, it is necessary to modify its construction by adding a poppet valve in the cylinder head, timed so gas isn't admitted until the exhaust ports close. This avoids blowing gas out with the scavenging air. The supply pipe needs a throttle valve to control amount of gas going to the cylinder.

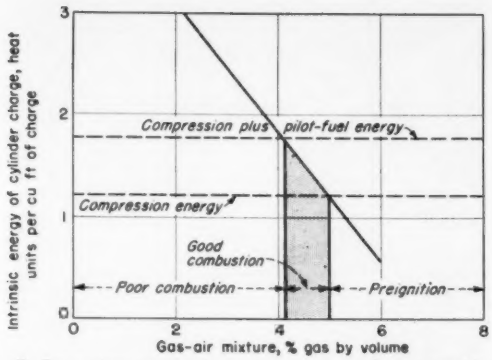
With these additions, and with fuel injection at the 10% "pilot oil" position, gas admitted to the cylinder will mix with the air charge and be compressed. Heat of this compression will ignite the pilot oil when it is injected and its burning will ignite the gas-air mixture. Opening the gas valve far enough to load the cylinder to 70 bmep produces the "gas" curve of Fig. 2, with a peak of only about 800 psi.

Thus by adding only a mechanically operated valve, a gas header and a throttle valve, a conventional diesel can be operated on the dual-fuel principle. In essence, this is what has been done in applying dual-fuel operation to the existing line of Fairbanks, Morse 2-cycle engines and in development of the new 8½x11½-in. model, although physical details vary.

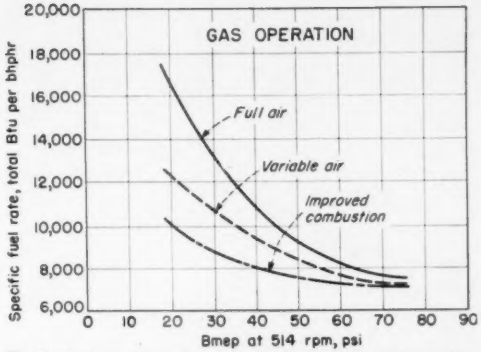
Control, Governing. A control and governing system for a dual-fuel engine must: (1) govern on fuel oil only (2) govern on gas plus pilot oil (3) provide automatic conversion from one fuel to the other, which includes supplementing the gas supply with diesel fuel when the gas supply runs low, and (4) provide for safe operation under all conditions. Fig. 3 shows such a governing system.

Basically, it differs from a standard diesel-control system only in that but half the total governor travel is used for oil operation. The other half controls position of a gas-throttle valve, with oil injection cut back to the pilot level. If both manually and hydraulically operated gas valves are open, the engine runs on gas as long as the supply is sufficient. If enough gas is not available to carry the load, the governor moves the levers in, to contact the fuel racks of the injection pumps, which supply enough oil to make up the deficiency. If the gas supply fails entirely, or is shut off at the valve, the engine automatically operates as an oil diesel.

Safety Features. This control system incorporates the following safety features: (1) If engine lube-oil pressure, the hydraulic actuating medium, falls below a predetermined value, the gas supply is shut off. (2) If the engine over-speeds, another pilot valve opens and drains lube oil to the crankcase,


Intrinsic energy of cylinder charge, heat units per cu ft of charge
Compression plus pilot-fuel energy
Compression energy
Good combustion
Poor combustion
Preignition
Gas-air mixture, % gas by volume

6 For a given compression ratio and engine design, too-rich mixture means preignition, too-lean means poor combustion



7 Curves show improvement in part-load economy obtained by governing scavenging-air supply and bettering combustion

shutting off the gas supply. (3) If the fuel-oil supply, and thus the pilot-fuel supply, fails, a third pilot valve drains out lube oil and closes the gas valve.

The need for this last element is indicated by tests showing that, in general, loss of pilot fuel in one cylinder causes light explosions in the exhaust manifold, loss in two cylinders causes quite heavy explosions which blow gaskets, and loss in three cylinders results in violent explosions.

Knocking. Perhaps the most important results of the development program lie in data gained on some of the basic factors involved in dual-fuel operation, particularly with respect to combustion of gas-air mixtures. In early work, "knocking" proved a problem. Degree of intensity varied, ranging from light, intermittent knocking to heavy "sledge-hammer" knocking at overloads. With knocks of medium intensity, top compression rings would break after two or three hours of operation, and with heavier knocks top ring lands would shear.

Observation of cylinder pressure-time diagrams on a cathode-ray oscillograph revealed that: (1) Audible knocks were invariably accompanied by pre-ignition on this particular engine (8½x11½-in. model) and that they were most frequent in cylinders where pilot fuel had poor control of the point of ignition. (2) Cylinders with unstable ignition timing had the highest average peak pressures. (3) Peak-pressure unbalance was excessive, sometimes as much as 250 psi from cylinder to cylinder at full load. It was concluded that improved fuel balance to the various cylinders was essential to prevent knocking.

A series of tests on ways of improving the gas balance led to a satisfactory balance with a properly proportioned gas header and gas-valve timing set the same on all cylinders. Pilot-fuel balance was, however, poor and was definitely contributing to peak-pressure unbalance. This discovery prompted a complete study of pilot-fuel injection.

Pilot Injection. It was found that the main injection pumps, then used for pilot injection as well, were actually pumping with zero effective stroke on the small pilot quantities because of the large plungers and barrels. That is, both the injection-pump port and the injection nozzle valve were open at the same time. Thus any change in conditions at the nozzle, such as opening pressures or spray-hole orifice areas, resulted in a change in quantity of fuel injected. In this case, quantity of pilot fuel was about one-half that required to idle the engine, about 0.003 cu in. of fuel per stroke. For this reason it was decided that a small-diameter pilot pump would be needed to obtain constant quantity of fuel to each cylinder. For the new 8½x11½-in. engine a duplex pump was chosen, with a small plunger for pilot injection mounted on top of the main injection plunger. This permitted use of a single camshaft for pilot pumping, main pumping, and gas-valve actuation. In converting existing engines a separate fuel pump is employed for pilot injection, driven from an additional, enclosed camshaft, which also actuates the gas valves.

Performance. With adoption of separate injection for pilot fuel and close tolerances on gas-valve timing to insure equal pilot and gas charges to all cylinders, manufacture of the new engine was started. Several of these units have now been in successful operation for 7000 to 12,000 hr. Fuel consumption has equaled or bettered that of the experimental engine, Fig. 4.

Full-load gas-diesel performance of the 8½x11½-in. engines is compared with oil-diesel operation in Fig. 5, which shows burning rates and pressures with the two fuels. In each case, engine input is nearly the same (7250-7400 Btu per bhphr) and power output is identical. In other words, engine efficiency is comparable. The curves illustrate graphically what can readily be detected by ear; combustion in the gas diesel is quieter, smoother, better controlled even though at least 90% of the fuel is present in thoroughly mixed form throughout the entire compression stroke.

A glance at the fuel-consumption performance of the engine at this point of development, Fig. 4, compared to that of the same engine on oil operation shows clearly, however, that steps to improve part-load economy were needed.

Part-Load Economy. Analysis of possible causes for poorer light-load performance naturally led to the conclusion that the gas-air mixture was so lean, at least in parts of the combustion chamber, that flame-quenching occurred and some gas remained unburned. Exhaust-gas analyses showing increasing amounts of unburned gas as load is reduced prove this theory.

Developments widening range of efficient combustion in a gas diesel can probably be best explained by looking at the general theory of combustion of gas-air mixtures. First, there is a maximum fuel-air ratio that cannot be exceeded without preignition. This point is shown by the intersection of the compression-energy line and the mixture curve in Fig. 6. In the case of this particular engine, with 15.5 to 1 gross compression ratio, it occurs at about 5% gas-air mixture. Second, for complete burning, without quenching, the gas-air mixture must not be leaner than shown by intersection at the compression-energy-plus-pilot-oil line. On this

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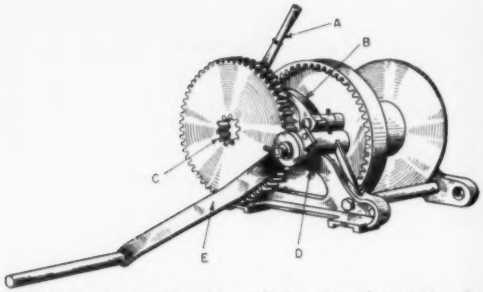
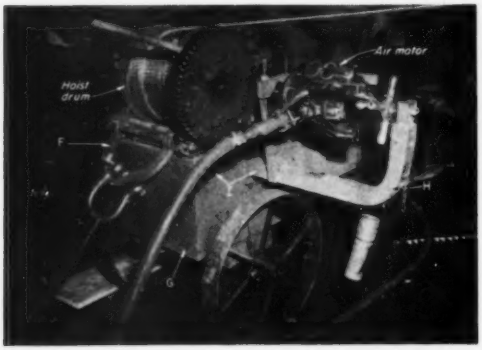
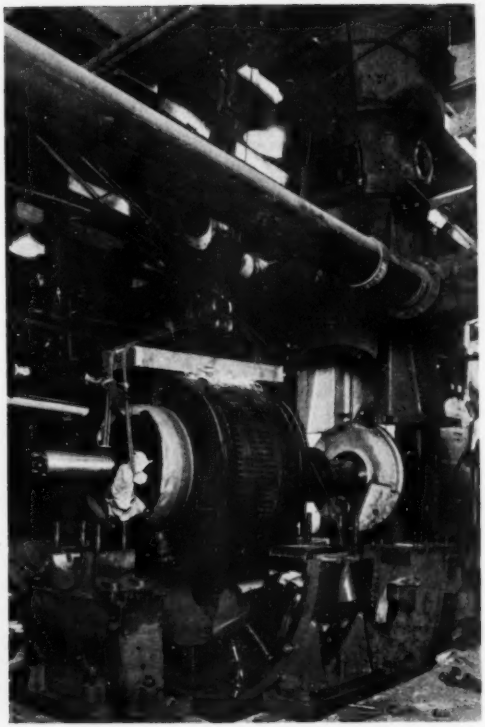


1 Utility hoist fitted with crank for manual operation is rated at 5-ton capacity, works at two reducing gear ratios



2 Hoist mounted on box G and fitted with anchoring yoke *F* is driven here by air motor ordinarily used for drilling



3 This 4-ton motor rotor and dry-vacuum pump impeller was lifted by one hoist through block and tackle held above

Utility Hoist Powered by Shop Tools

Adaptation of standard hoist to lifting jobs throughout the power plant has proved safe and economical over fifteen-year period. Shop-tool power makes for speedy one-man operation

By **FRANK F FISHER**
Construction Department
The Detroit Edison Company

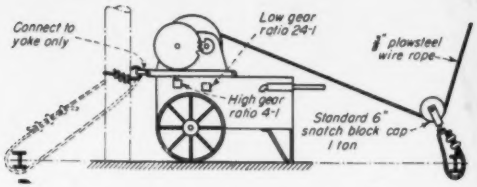
► PRACTICALLY ALL EQUIPMENT in a power plant is placed and erected with the aid of hoists varying in type and size. As construction progresses in new stations, every wall and floor added form barriers limiting the usefulness of these hoists. In areas not served by house cranes the application of power-operated hoists, or derricks capable of lifting equipment or its components, becomes increasingly circumscribed.

In existing stations, too, this problem may become of prime importance. Often erectors and repair men must either install elaborate hoisting equipment or resort to slow and cumbersome hand methods. In The Detroit Edison Co the erectors have overcome these difficulties by using portable utility hoists developed by the construction department. Ordinary shop tools power these hoists but they may be manually operated if desired. Each hoist can handle six tons. Two or more hoists can be used for heavier loads. They are small, readily moved and anchored in a position of advantage.

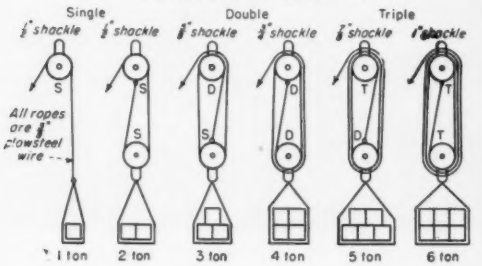
Reduce Handling Costs. Material handling forms a major cost item in installing power-house equipment. Efficient handling will reduce installation costs and save time as well. To realize these ends more versatile hoists had to be developed. Their basic requirements were established by experience and observation.

The vast majority of lifts in areas not served by house cranes do not exceed four tons. But it was advisable to increase capacity to six tons. Hoists have to be safe and practically foolproof because they are operated by all kinds of

TYPICAL INSTALLATION OF UTILITY HOIST

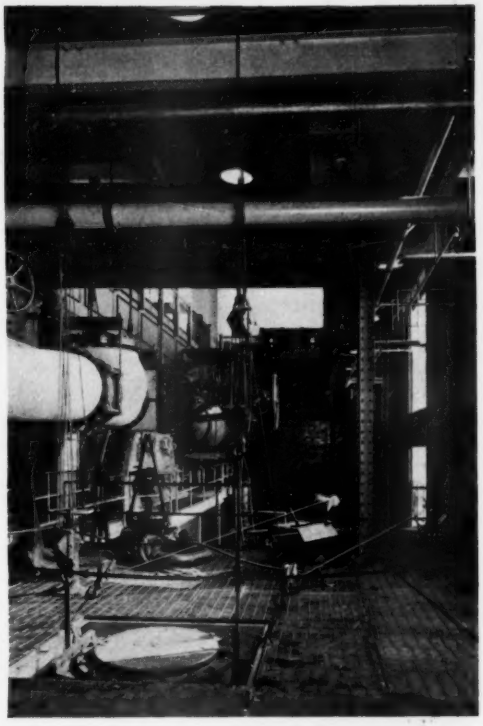


SHACKLE SIZE NOT LESS THAN



SAFE WORKING LOADS FOR WIRE ROPE SLINGS (LBS)

Size	Choked	Straight	Angle betwn legs 60°	90°	120°
⅜	750	1500	2550	2100	1500
½	1200	2400	4100	3400	2400
⅝	2000	4000	6800	5600	4000
¾	3000	6000	10200	8400	6000
⅞	4000	8000	13600	11200	8000
1	5000	10000	17000	14000	10000
1¼	8000	16000	27000	22000	16000



4 Two utility hoists in parallel lifted the 8-ton cylinder of dry-vacuum pump shown in Fig. 3. One man controls hoists

men, experienced and inexperienced. They must be easily handled, moved and rigged, require little head room, be versatile in locations not accessible to conventional types. Furthermore, they must be mechanized to eliminate time-consuming drudgery and hard labor, the main objection to any manually operated hoist. The hoists described here have conclusively demonstrated their superiority to other conventional types.

A well-known make of hand-operated hoist, which was chosen for adaptation, had several outstanding features. Built of steel castings, it was designed to include a hand brake and safety dog as shown in Fig. 1, *A* and *B*. The drum was guaranteed to sustain a working load of 5 tons. The hoist can be anchored to any convenient and suitable object by ropes or cables attached to the yoke in its base, as at *F* in Fig. 2. Any load acting on the drum transmits directly to the anchoring point.

This simple anchoring feature makes the hoist portable, especially when mounted on a box equipped with two wheels, as in *G* of Fig. 2. The box also acts as a receptacle for tools and hoisting gear. Manual power for operation can be applied in two ways. For light loads, a pinion integral with a stud shaft carrying an adjustable crank handle *E*, Fig. 1, fits and locks into a counter-sunk recess *C* in the center of the external gear. This gives a reduction in drum speed of 4:1. For heavier loads the pinion meshes with the external-gear teeth, *D*, Fig. 1. In this position the gear reduction is 24:1.

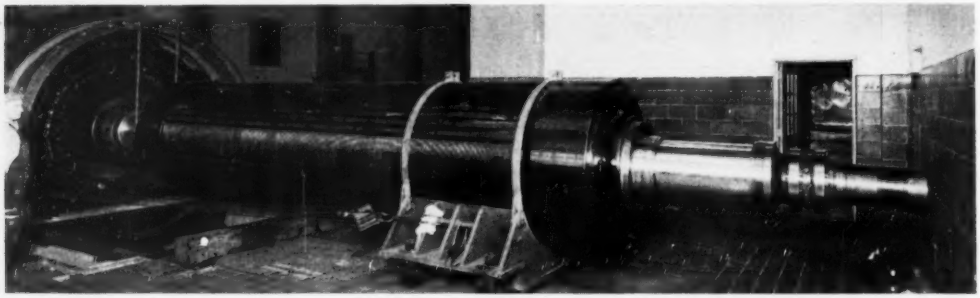
Motor Power. The unique locking-pinion drive makes it practical to motorize the hoist. The only change is the substitution of a Morse taper shank for the adjustable hand crank furnished. Any suitable air or electric motor fitted with a Morse taper socket or other suitable means may be used for motive power. Economical motorizing utilizes standard portable power tools. For example, air drills are available at all power plants.

A fixture holds the motor in position, Fig. 2. It is adjustable to the motor size and attached near the top of an L-shaped holder, *H*. The longer leg of the holder, made of 1¾-in.-square steel tubing, slides through correctly positioned square steel sleeves *I*, welded into the box in a position parallel to the drum. Length of the holder adjusts to different types of motors and tools. When fastened the holder can neither slip nor turn but secures the motor firmly. This arrangement relieves the operator of all physical effort, leaving him free to attend to the motor controls.

To develop needed lifting capacity with most power tools it is necessary to use multi-sheave blocks. A machine capable of drilling 1¼-in. holes can raise four tons when operating the hoist in low gear and rigged with triple sheave blocks. A machine capable of drilling 1½-in. holes can lift five tons under the same conditions. This load is also maximum capacity for manual operation. A machine capable of drilling 2-in. holes is good for six tons or more.

The instruction chart shown above is attached to every hoist. This gives the preferred hookup, minimum size of shackles and the blocks to use for dif-

5 Air-motor-driven hoist, anchored in position, is hooked up for lifting tools and materials up to motor room of gantry crane in preparation for an inspection and repair program. Block combination can be altered to suit load, speed operation



6 Pulling 100,000-kva generator rotors in and out of stators is made easy work by using two utility hoists for moving power. Here one hoist attached to each side of carriage through block rigging is reinstalling generator rotor

ferent loads. Best suited for the hoist is $\frac{3}{8}$-in. wire rope because it is flexible—not bulky—and carries a one-ton load safely. As much as 425 ft can be wound on the drum. These features give the hoist a wide load range and make rigging a simple one-man affair. For instance: a set of triple-sheave blocks good for six tons weighs only 75 lb completely reeved, only a fraction of the weight of a 6-ton chain fall. Light weight and easy rigging are two of the reasons for the hoist's popularity.

Safety Record. Wire-rope blocks are made of steel and the sheaves are 6-in. dia. Heavy-type commercial blocks are nominally suitable for the expected loads, but we decided to increase the block-strap thickness to $\frac{3}{8}$ in. and add supporting straps between the sheaves. No block failure has occurred in over 15 years' use of 30 hoists in continuous duty on jobs of every description. As a matter of fact, neither has there been a hoist failure, nor do the records show any accidents caused or induced by these hoists—an exceptional safety record.

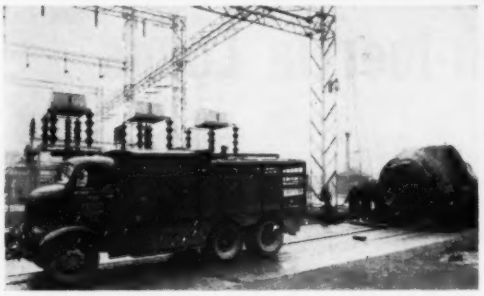
Because this small, loosely anchored hoist, powered by a detachable common air drill, at the time of its introduction was a radical departure from conventional practice, several years elapsed before it was fully accepted. At first, men were actually afraid to use the hoist because it and the cables appeared to be out of all proportion to the loads carried. Since then it has become a very popular tool, the "maid of all work" for electricians, steelworkers, pipe fitters, boiler erectors and others. The pictures illustrate its versatility.

Applications. The hoist in Fig. 2, anchored on a boiler walkway, raised and lowered superheater elements weighing 600 lb between boiler roof and ash aisle with a single line. Fig. 3 shows the erection of a vertical dry-vacuum pump in cramped quarters. After one hoist picked up the 4-ton motor rotor mounted on a crankshaft, another hoist drifted it into position. The suspended 8-ton cylinder and crankcase of this machine are also shown. This part had to be raised before assembly could proceed. Fig. 4 shows the two hoists as well as the simple rigging that handled this piece.

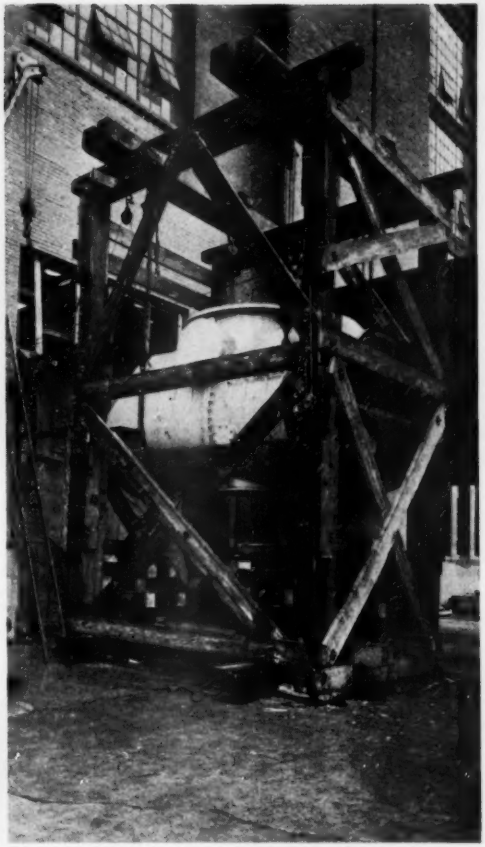
In Fig. 5 a hoist conveys material and tools with a single line to and from the machine room of a gantry crane, 90 ft above ground. Suitable block combinations handle heavier parts.

The same hoist, fitted with triple blocks, can turn the rotor of a 50,000-kw turbine while on the inspection

7 Rigging trucks for general work on system are fitted with utility hoist to supplement regular truck capstan, rear



8 Rigging truck moves a house service condenser to a new location after helping in its removal, as shown in Fig. 9



9 Four utility hoists lowering service condenser, after removal from building, from cribbing to skids down below

stand. By using two hoists, one on each side, generator rotors can be pulled and reinstalled easier and faster than with conventional laborious manual methods employing jacks. Fig. 6 gives an example of the handling of a 100,000-kva rotor weighing about 92 tons.

Fig. 9 shows the heaviest load, 26 tons, handled by these hoists. This house-service condenser was removed from a position not accessible to heavy cranes. It was removed through a window onto the temporary cribbing shown, then raised by four hoists, each having two triple and one single block, to make the removal of two supporting beams possible. The condenser was then lowered onto a set of skids and rolled under the house crane for loading, as shown in Fig. 8, where it is headed for the condenser room.

These hoists have also proved useful in work on transformer mats, in switching stations, substations and for work requiring the use of "gin" poles. In many such places it is more convenient to power the hoists with electric drills or in some cases to operate the hoist by hand.

Rigging Truck. Fig. 7 shows a hoist carried on a "rigging truck," so named because it furnishes transportation for its crew, power for hoisting or moving, and carries ample equipment that may be needed to handle any rigging job. According to circumstances the hoist supplements or supplants the power capstan of the truck. It also enables handling work in locations that cannot be served by the truck capstan.

Fig. 8 shows the truck moving a condenser. The 8-ton capacity truck has a 16-ft special stake body mounted on a cab-over-engine chassis having a short turning radius. To withstand the heavy stresses on the chassis, both ends are greatly reinforced. The truck is unique in that no improvements have been offered or needed during its eight years of service.

Other Uses. The hoists can be adapted to making lifts with beam trolleys having no permanent hoist. One method suspends the load by clamping together the hauling cable and one wire rope of the blocks, rolling the loaded trolley clear wtih a repositioned hoist, lowering load after releasing cables.

Cost of a hoist completely equipped approximates the cost of a 6-ton chain block, but the hoist is equally safe and efficient for light as well as heavy loads and short or long lifts. It has materially decreased costs of erection and repair as well as lowering the accident rate to a minimum.

1 This induced-draft fan has a high inertia and is driven by a 700/450-hp, 900/720-rpm multispeed, squirrel-cage motor. To use standard motor, hydraulic coupling is inserted between motor and fan, allowing the motor to start unloaded

Motors for High-Inertia Loads

Inertia of connected load is often overlooked when selecting motors. Here is a summary of salient points to consider in addition to method of computing the load's moment of inertia

By **HENRY OMAN**, *Electrical Engineer*
Allis-Chalmers Mfg Co, Milwaukee, Wis.

► WHILE THE TERMS starting torque, pull-in and pull-out torque, speed, line-voltage, etc, are generally understood and carefully specified by engineers when ordering motors, the inertia of the load to be driven by the motor is one of the little-known factors that materially affects motor cost.

In industrial plants, high-inertia loads are often present in centrifugal and positive-displacement rotary-type blowers, centrifugal and propeller fans, reciprocating compressors, and vacuum pumps. High-inertia loads can be found in bandsaws, gang saws and trimmers in saw mills, as well as in chippers, wood hogs and shredders in paper mills. The inertia of rotating parts in these drives is often a major influence in determining the most economical type of motor.

Calculating Inertia. Moment of inertia of the load is called the load WK^2. It is expressed in pounds-feet-squared at the motor shaft where W is load weight in pounds and K is radius of gyration. Weight of the driven element can usually be calculated or obtained by weighing while the radius of gyration can be calculated from handbook formulas with sufficient accuracy for motor application work. For example, the radius of gyration of a flywheel with spokes will be the distance from shaft center to some point in the rim.

Another thought to keep in mind is that the WK^2 a motor is called on to accelerate is varied if a speed changer is inserted between motor shaft and load. In this case the equivalent WK^2 at the motor speed is equal to WK^2 of load x (load speed^2 ÷ motor speed).

Squirrel-Cage Motors. When a squirrel-cage induction motor is called on to accelerate an inertia load from zero to operating speed, the energy released in the rotor bars equals the final kinetic energy of the load. This energy will be greater if there is any other load in addition to the inertia.

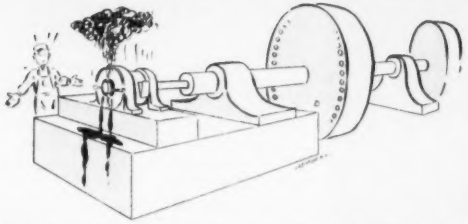
For the case where the load itself has a high WK^2, the energy generated in the rotor may be the determining factor when it comes to selecting motor size. Length of time required to accelerate the load does not influence directly the quantity of heat liberated in the rotor as long as the inertia load predominates. Hence, use of a reduced-voltage starter does not, as a rule, materially improve a motor's capacity for accelerating high-inertia loads.

Rotor winding of a squirrel-cage induction motor has essentially no insulation; its end connections are usually brazed or silver soldered. Offhand reaction would be that construction of this type could easily withstand a much higher temperature than the stator winding. Nevertheless, there are other considerations that limit the permissible temperature.

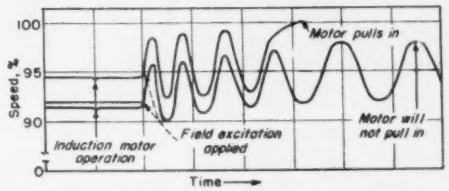
One limiting factor in rotor-bar temperature rise is differential expansion of the copper in the bar with respect to the iron in the core. If the copper were to move with respect to the iron, the end rings could be easily distorted, or all the clearance might slide to one end of the rotor.

The motor designer can readily calculate temperature rise of the rotor bars knowing that 176 watt-seconds of energy

HERE'S WHAT HAPPENS WHEN MOTOR IS NOT MATED TO LOAD



2 Motor, obviously undersized, is connected to tremendous flywheel. This article answers question in operator's mind



3 Synchronous motor's dc field is applied after rotor has been accelerated to stable speed by squirrel-cage winding

will cause one pound of copper to rise one deg C if it absorbs all the energy. He will also take into consideration the heat radiated or conducted away from the rotor bars during the acceleration period, in addition to the heat resulting from the regular load torque during acceleration.

At present there are no standards covering the high-inertia accelerating capacity of large squirrel-cage induction motors. Usual practice is to check with manufacturer to see if his motor can satisfactorily accelerate the load involved. Sometimes, to get a rotor with adequate thermal capacity, it is necessary to specify a motor larger than actually required.

On the other hand, the wound-rotor motor is quite adaptable to acceleration of high-inertia loads. In this type motor, the rotor temperature rise can be kept down because much of the heat generated is dissipated in the rotor resistor, which is external to the rotor winding. The wound-rotor induction motor is also adaptable to cases where you do not want a high rate of acceleration since varying the value of the secondary resistors can control acceleration.

Synchronous Motors. Pull-in torque as well as thermal capacity is a major consideration in synchronous motors as far as ability to handle high-inertia loads is concerned. In a squirrel-cage motor, design of the rotor bars affects slip and efficiency as well as starting torque. In a synchronous motor the squirrel-cage winding is used for starting only; hence the design engineer can design the cage winding to get the desired starting and pull-in torque without regard for normal running load.

Cage winding in a synchronous motor accelerates the load to about 93 to 98% of synchronous speed. After this speed is reached there isn't enough slip to generate a rotor current large enough to accelerate the load further. The motor is then pulled into synchronism by applying dc field excitation. This action is shown graphically in Fig. 3. When the dc field is applied the rotor will accelerate in an attempt to catch up with the revolving areas of concentrated stator flux of the opposite polarity. As the dc field poles approach these areas the rotor will decelerate. When the peak of the pulsation curve equals the synchronous speed the motor will normally pull into step.

It is apparent from the curves in Fig. 3 that the amount of inertia or flywheel effect has an important bearing on the speed pulsations. If the motor is accelerating an extremely-high-inertia load, magnitude of the speed pulsations will be reduced. If the motor is not designed for this condition it will fail to pull into synchronism.

A synchronous motor is normally started with the field connected across a discharge resistor. Value of this resistor has a bearing on the rotor's final slip speed because the field winding steps into the picture in a manner similar to the squirrel-cage winding as synchronous speed is approached. Where the discharge resistor is properly designed, the rotor with a high-inertia connected load will approach closer to synchronous speed before the field is applied. As a result it will require smaller speed pulsations to bring the rotor into synchronism.

Basis for standardizing the ability of synchronous motors to accelerate high-inertia loads is called the normal load WK^2. This factor may easily be calculated using the following formula:

Normal load $WK^2 = 3.75 \times 10^5 \times (\text{motor hp}^{1.15} \div \text{rpm}^2)$. Take, for example, a 400-hp 900-rpm synchronous motor. In this case the normal load WK^2 equals $3.75 \times 10^5 \times (400^{1.15} \div 900^2) = 455$ lb ft^2.

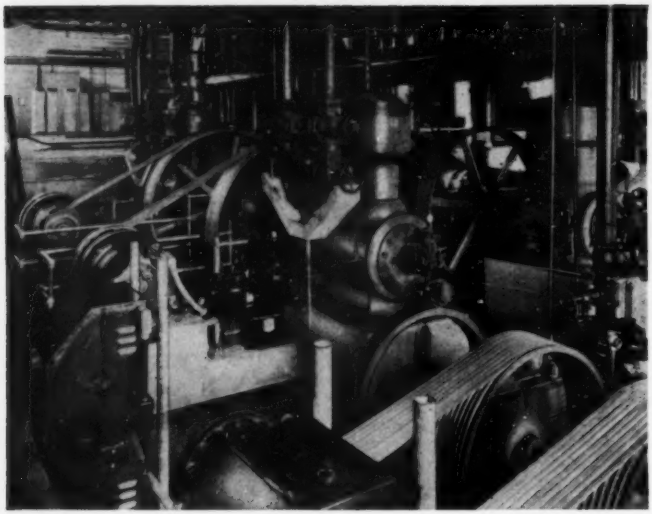
As a general rule, manufacturers of large synchronous motors do not ask a premium even though motors may be required to start high-inertia loads up to ten times the normal load WK^2. This is usually true even though a special design may be required.

DC Motors. Where high-inertia loads must be frequently accelerated or decelerated there is no real substitute for the dc motor. It doesn't matter whether it is supplying power for an inertia or other load so long as the maximum allowable current input is not exceeded. Controls can be provided for uniform acceleration or in accordance with operating needs.

Dc motors naturally require a dc supply, which is not always conveniently available in modern plants. For small high-inertia drives the cost of conversion equipment may offset the advantages of dc-motor drives.

For a large dc motor it may be necessary to use an mg set for the electrical-power conversion. If so, motor speed can be varied by adjusting the field of the supplying generator, thereby providing an extremely flexible installation. Where a motor drives a load that is frequently stopped or reversed, a flywheel is often installed on the supporting mg set. The set, in turn, is driven by a wound-rotor motor that can be made to slow down if the load suddenly becomes high. Result is the inertia energy in the flywheel then supplies part of the driving power, reducing the maximum electrical load on the power supply. When the peak load is removed, the flywheel is accelerated as it gets ready for another cycle.

Conclusion. Squirrel-cage motors are limited in inertia-accelerating capacity by the ability of the cage winding to absorb heat. Synchronous motors, on the other hand, have the additional problem of pull-in torque. Dc motors can accelerate a high-inertia load without difficulty as long as the designed armature current-carrying capacity is not exceeded. Wound-rotor induction motors are suitable for use with high-inertia loads provided the secondary resistors can absorb or dissipate the heat generated by the rotor current.



COMPRESSOR DRIVES. In this refrigeration plant there are six compressors: four are driven by 60-hp and two by 30-hp ac induction motors through multiple V-belts

Twelve Causes of Short V-Belt Life

It's not enough to select the size and construction for an application, says George Holman, refrigeration service engineer. Long, troublefree belt life requires intelligent care

► To get long life from multiple V-belts, correct selection and maintenance practices must be combined. The interesting article, "How to Select the Most Economical V-Belt Drive," by Frank H Rumble, Dec 1948 Power, is useful only if proper selection is followed by equally intelligent application and care. No matter how well chosen a drive may be, several application factors are frequently overlooked that shorten belt life. Among these are:

1. *Overtension.* A belt operated too tight will have a short life. The best selected drives may be ruined in a short time by excessive tension.

2. *Undertension.* If the belts do not have enough tension they will slip, particularly when starting their load. Slipping in the sheaves' grooves causes excessive surface wear and heating of belts, from the surface inward. This heating destroys the binding element in them, and hardens and cracks rubber.

3. *Unequal-length belts.* If V-belts vary much in length it is impossible to adjust shaft-center distance so the longer belts carry their share of the load without overstressing the shorter ones. If shaft-center distance is adjusted to put proper tension in the shorter belts, they must carry most of the load and so are overloaded. When the slack strands of the belts are on the under side, the longer belts fall away from the sheaves more than the shorter ones. Consequently, the longer belts have a reduced arc of contact on the sheaves. This condition causes the longer belts to slip more, but slippage of the shorter belts also increases because of increased load. Undertension and overtension belts are both damaged.

4. *Idle belts.* Do not let belts stand idle under tension for long periods. If a drive is to be idle for a long time, slack off on the belts to prevent their setting to the shape of the sheaves.

5. *Over-age belts.* Rubber deteriorates with age. Therefore belts can lose part of their useful life if left on a shelf for a long time before being put into service.

6. *Dirt on belts.* Dust, grease, oil or other foreign matter on belts shortens their life, by increased wear, slippage and other causes. Foreign matter such as oil or chemicals may also penetrate the belts' surfaces and destroy the material from which they are made.

7. *Atmospheric conditions.* Atmosphere in which the belts run is also an important factor in their life. Air in many plants contains abrasive dusts, oil vapors, acid fumes, or other gases and vapors injurious to rubber belts.

SHEAVES AND GROOVES

8. *Sheaves.* Sheaves out of alignment is a major cause of belt slippage, distortion and internal heating. For long belt life, sheave grooves must be in good condition and the sheaves of the drive in correct alignment.

9. *Sheave grooves.* Belts must fit the grooves correctly. Most new sheaves are correctly grooved for their belts, but the groove sides wear until they do not have correct belt angle, or the belts ride the grooves' bottoms. This may make it necessary to put excessive tension in the belts to drive the load.

10. *Rough grooves.* If the groove sides have been roughened by misuse, corrosion or rusting, excessive wear of belts may be expected with short life.

11. *Overload when starting.* Starting a drive under excessive overload puts the belts under momentary overtension. While breakage of belts is rare under these conditions, slippage is common as is damage from overtension necessary to get the load started.

12. *Vibration.* Vibration of driving or driven machine sometimes causes whipping or snapping of belts. This action may seriously damage them and shorten their life.

These and other conditions must be taken into account, in addition to those contributing to the most economical drive, or the selection may not be economical. Selection is only half the problem, and must be accompanied by intelligent operation before long belt life can be obtained.

ELECTRONICS FOR THE POWER ENGINEER

By F A ANNETT, *Associate Editor*

13—Mercury-Pool Rectifiers

► ANOTHER GROUP of electron tubes falls in the class known as mercury-arc rectifiers. They have a mercury-pool cathode, Fig. 1, instead of a hot-metallic cathode, such as thyratrons and others have. During operation of the rectifier, the surface of the pool develops one or more hot spots that emit free electrons.

Starting Methods. These rectifiers can be heavily overloaded for short periods without injury, but some means must be provided to initiate emission of electrons from the mercury-pool cathode. One method of starting, used with the old glass-bulb rectifiers, Fig. 1, tips the tube until mercury flows from the pool to the starting anode. A current then flows from the center of the transformer through the load, mercury pool, starting resistance, and to the right-hand terminal of the transformer.

Returning the tube to the vertical strikes an arc between the starting anode and mercury pool. Electrons are then emitted and current flows from the cathode to main anode *B*, as indicated. The tube is now in service and the starting switch can be opened. When line voltage reverses on the transformer, the left-hand section of its secondary becomes active, with anode *A* in the dc circuit.

If current stops flowing through the tube for even a small fraction of a second, operation ceases and starting has to be repeated. A reactor coil retains current through the mercury-pool cathode and one anode until current starts to flow through the other anode.

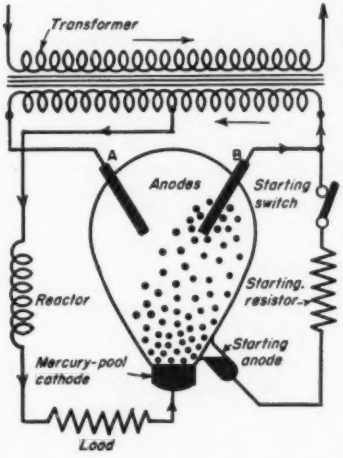
Large Rectifiers. Until recently, large mercury-arc rectifiers were contained in watercooled steel tanks, with as many as 24 anodes in a single tank. Power taken from a 3-phase supply is converted into as many phases as there are anodes in the rectifier by the step-down transformer. Such units are complicated machines with automatic starting equipment, vacuum pump to maintain the vacuum within the tank, mercury condensate pumps and other equipment—all automatically controlled.

Fig. 2 is a cross section through a watercooled mercury-arc rectifier, showing one of its 6 or 12 main anodes, the starting anode and one of two excitation anodes. The excitation anodes are small and placed closer to the cathodes than are the main anodes; consequently a low voltage and current maintains an arc between them and the cathode, to keep the rectifier in operating condition even at zero load on the main anodes.

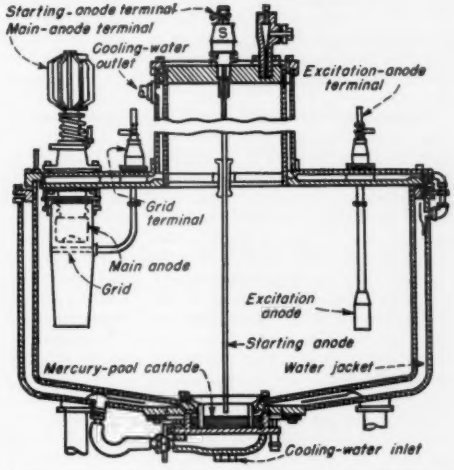
To start the rectifier, close its starting circuit, which first energizes solenoid *S* on the starting anode to pull it down into the mercury-pool cathode, against the tension of a spring. Deenergizing solenoid *S* permits the starting anode to return to its normal position.

When the starting anode pulls out of the mercury a hot spot forms that emits free electrons. These electrons flow to the excitation anodes because of the

Glass Bulb and Multi-Anode Steel-Tank Mercury-Arc Rectifiers

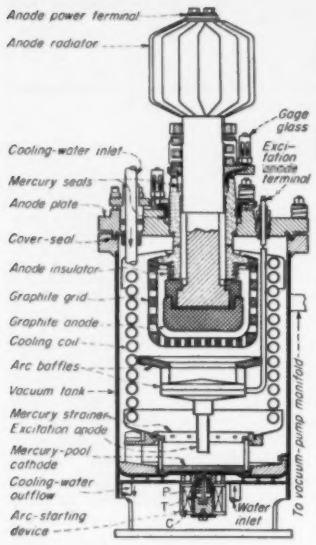


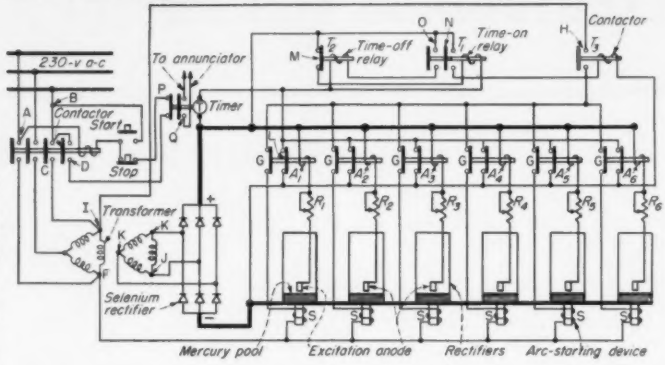
1 Instead of a hot-metal cathode, as with thyratrons, this mercury-arc rectifier has a mercury pool. During the operation on the mercury pool, hot spots form that emit electrons



2 Cross section through a large watercooled mercury-arc rectifier shows one of the six or twelve main anodes, as well as one of two excitation anodes and the starting anodes

Single-Anode Multi-Tank Mercury-Arc Rectifier and Starting Circuits





3 Ignition and excitation circuits for a 6-tank mercury-pool rectifier. Closing the start button initiates excitation by closing contactor C to supply power to the excitation system from a 3-phase 50-ampere 35-volt selenium rectifier

4 Cross section through single-tank mercury-pool rectifier shows graphite anode and supporting shaft in insulator held in anode plate along with graphite grid. The arc-starting device with its magnet-actuated plunger is in the tank's bottom

latter's positive potential. Since these anodes have a closed circuit for current flow they start operating. After the excitation anodes have created operating conditions within the rectifier the main power electrodes start operation a soon as their circuit breaker connects them to a load.

Also built in capacities up to 750 amp are rectifiers of this design cooled by a fan blowing air over them. Control of the ignition and excitation electrodes of these rectifiers is the same as for watercooled designs. All these rectifiers can have their voltages regulated by a grid in much the same way as a thyratron.

Single Anode Designs. To eliminate some of the operating difficulties with multi-anode rectifiers and to increase their efficiency, particularly at voltages below 300, single-anode designs have come into general use. One of these, the excitron, Fig. 4, has a single water-cooled tank in which are the main anode, control grid, excitation anode, mercury-pool cathode and starting device. An insulator set in the anode plate supports the graphite anode. This plate also supports the grid, excitation anode, mercury-arc baffles and internal cooling coils.

A steel sleeve supports the graphite grid on a large petticoat on the anode insulator. A Nichrome wire connects the grid to a grid terminal-rod sealed in the anode plate. Skirts separated by deep grooves on the lower part of the anode insulator provide high insulation between the anode and grid.

Supported below the grid are the arc baffles to protect the anode and grid from heat radiated by the cathode spot on the mercury pool and to give better control of mercury vapor in the critical zone surrounding the anode. Bottom of this baffle carries the graphite-bar excitation anode.

A watercooling coil, supported by its inlet and outlet pipes in the anode plate, surrounds the anode, grid and arc baffles. This coil is insulated from the tank to prevent an arc starting between tank wall and anode. The excitation anode connects to a sealed-in terminal in the anode plate.

A cathode in the bottom of the tank includes the pilot-arc starting device, spacing ring to confine the mercury pool in the center of the tank, and the insulating supports for the mercury strainer. Mercury vapor condensed on the cooling coil collects in the steel ring and flows through the strainer to the cathode pool. Graphite dust and other particles float on top of the mercury in the strainer ring groove and do not enter the cathode pool.

Because the cathode spots on the mercury pool have a high temperature the cathode is cooled by water. This enters near the center and flows in a spiral channel around the bottom of the cathode-plate surface before reaching the outlet pipe.

How Rectifier Operates. When a rectifier, which usually consists of six or more units, is put into service the pilot arc is first started in each tank. These arcs are started by a coil *C*, surrounding a plunger *P*, sealed in a tube *T*, welded to the tank's bottom. A spring holds the plunger up against the tank, but a hole through both permits tube *T* to fill with mercury.

Energizing the coil momentarily with 230-v ac pulls the plunger down and forces mercury up through its center hole to form a jet that contacts the excitation anode. The coil, energized for a fraction of a second under timing control, releases the plunger, which is returned by the spring to its original position. Collapse of the jet opens the circuit to produce a dc pilot arc so a cathode-spot excitation forms on the mercury pool. A selenium-plate rectifier through a current-adjusting resistor supplies pilot-arc current of 7 or 8 amp to each tank.

Fig. 3 shows the ignition and excitation circuits for a 6-tank rectifier. The system is energized by pressing the start button, which completes a circuit from *A* through the contactor coil to *B*. When contactor *C* closes it completes a holding circuit from *A* through the coil, the stop button, contacts *P* on the timer, contact *D*, back to the right-hand line.

Closing contactor *C* energizes the excitation transformer and applies 230-v ac to excitation coils *S*, from *F*, the excitation coils, through contacts *G* which are closed, contact *H* which is

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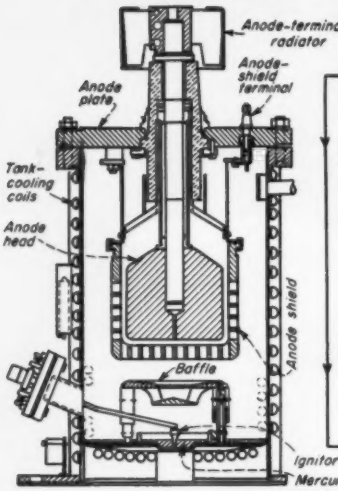
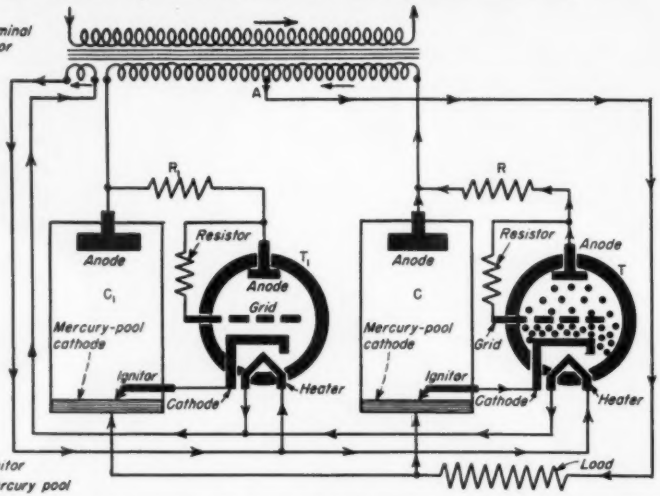
HYDROVAC *Dust Handling*

ALLEN-SHERMAN-HOFF CO., 227 S. 15th ST., PHILADELPHIA 2, PA. ***Offices & Representatives in Principal Cities***

Ignitron Single-Anode Mercury-Arc Rectifier and Ignitor Circuits



5 Cross section of ignitron mercury-arc rectifier with an anode shield



6 Thyratrons connected to two single tank ignitrons to fire "ignitor" and start each rectifier conducting in proper sequence according to transformer polarity

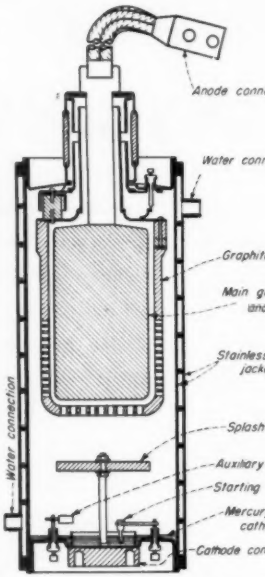
open, back to *I* on the transformer and to the line.

The transformer's secondary through a 3-phase full-wave 50-amp selenium rectifier applies 35-v dc to the excitation anode of each tank. At a given instant one of the circuits is from *J* on the transformer to the center leg of the selenium rectifier, the mercury-pool cathode of each rectifier tank, the excitation anode, which is still dead, resistors R_1 to R_8 and relay coils A_1 to A_8, back to the outside legs of the selenium rectifier and *K* on the transformer.

Excitation Circuit. When the dc excitation circuit is made alive by the selenium rectifier, timing-control circuits are also energized to establish the pilot arcs automatically. These circuits include a timer *T*, a time-on relay T_1, a time-off relay T_2, mutually interconnected with T_1 to actuate a small contactor T_3 in the starting coil *S* circuits.

Timer *T* limits the total time that the excitation circuits can be energized. Its circuit is from the selenium rectifier, contact *L* on each *A* relay, timer *T* and back to the rectifier. Time-on relay-coil circuit is also through the *L* contacts, contact *M* of time-off relay T_2, and back to the selenium rectifier.

When T_1 closes its contacts, *N* and *O*, a circuit is completed for contactor T_3 coil through *N* and for T_3 coil through *O*. Closing T_3 contact completes the circuit for coils *S* on the arc-starting devices. If these devices work properly they pull down their plungers and shoot a jet of mercury to the excitation anode.



7 A 400-amp ignitron in a permanently sealed watercooled metal tank

When relay coil T_2 was energized it opened its contact *M*, which opened the circuit through coil T_1. This relay opens to break the circuit of coil T_3 through contact *O* and that of T_2 through contact *N*. When contactor T_3 opens, it breaks the circuits of arc-starting coils *S*, and their plungers drop.

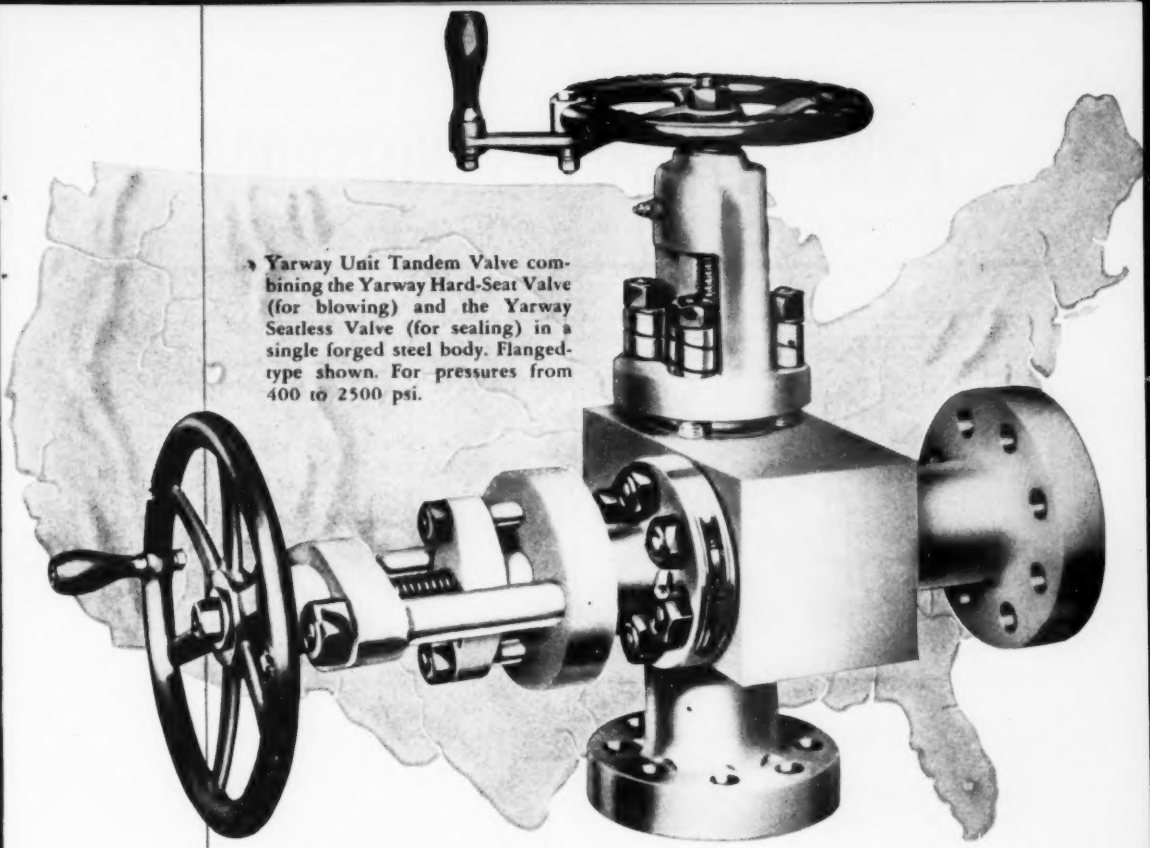
When the mercury jets collapse, if an arc is established between the mercury pool and excitation anodes the rectifier goes into service. These circuits are from the mercury pools, the excitation anode's resistors R_1 to R_8, relay coils A_1 to A_8, to the selenium rectifier.

If an arc starts and holds in all the tanks, then all the *A* relays open their contacts. The left-hand contact on each opens the circuit through arc-starting coil *S* and the right-hand contact opens timer *T* circuit and starting operations cease.

Timing relays T_1 and T_2 and contactor T_3, because of their action described, cause all arc-starting coils to be energized for about 0.3 second and then remain deenergized for the remainder of the second. In this time if any pilot arc fails to start, its relay *A* will not pick up to open the starting-coil *S* circuit, and the timing cycle repeats.

If a pilot arc fails to start because of some fault in its circuit, the timing control will continue to function for several seconds until timer *T* times out. When this happens contacts *P* open to break the circuit of *C* contactor coil. This contactor opens and the rectifier will not

(*Continued on page* 156)



Yarway Unit Tandem Valve combining the Yarway Hard-Seat Valve (for blowing) and the Yarway Seatless Valve (for sealing) in a single forged steel body. Flanged-type shown. For pressures from 400 to 2500 psi.

NORTH

WEST EAST

SOUTH

it's YARWAY 4 to 1

From every corner of the country comes the same story—four out of every five high pressure boiler plants are equipped with Yarway Unit Tandem Blow-Off Valves.

Each day's orders add to the evidence. From Ohio . . . 17 new Yarways, making a total of 746 purchased by this large utility over the last 35 years. From California . . . 10 new Yarway Unit Tandems for one company, 9 for another. Texas sends an order of 5 . . . 3 for one new municipal plant, 2 for another. Northern New York wants 7 for new boilers in a well-known utility. And so it goes.

Why this overwhelming preference?

Proved dependable performance, due to outstanding design, sound engineering and careful manufacture . . . plus constant research, leading to mechanical and metallurgical advancements that keep Yarway Valves ahead of changing service requirements.

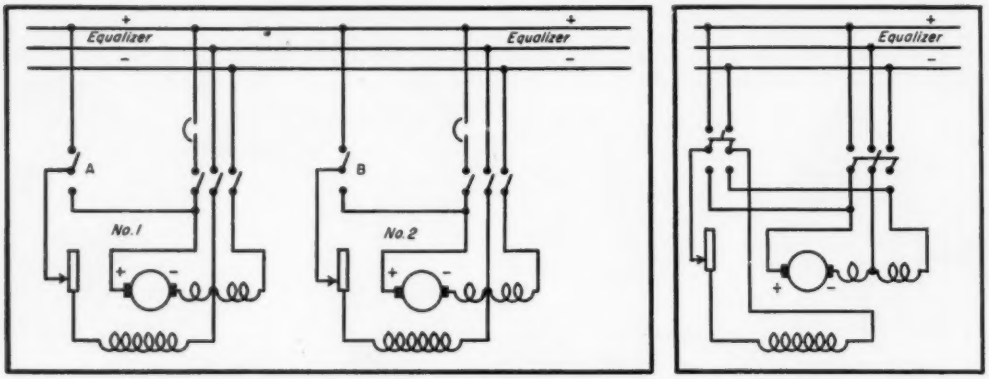
For latest information on Yarway Unit Tandem Blow-Off Valves, write for Yarway Bulletin B-432.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.

YARWAY BLOW-OFF VALVES

POWER ENGINEERS' NOTEBOOK

PLANT-TESTED IDEAS TO SOLVE PROBLEMS OF DESIGN, OPERATION AND MAINTENANCE



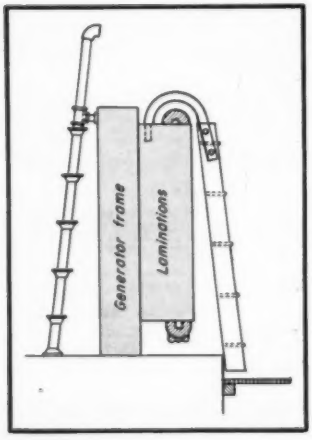
EXTRA SWITCH CORRECTS REVERSED POLARITY QUICKLY

OUR PLANT, like many others, does not have reverse-current relays for preventing current flow from bus to dc generator. This reversal occasionally happens with our compound-wound generators when the operator neglects to bring generator voltage up to bus voltage before putting a unit into operation.

It takes a lot of time to correct polarity of a large generator by lifting brushes or disconnecting cables. To make this correction quickly and positively, we found it paid to hook up extra small switches, as shown in the sketches above. Left-hand diagram shows the hookup when all the main switches are single pole. To correct polarity on No. 2 unit, close main negative switch, leaving other two open. Cut in most of field rheostat resistance, next close spdt switch *B* in upper position for a moment, then open and close in down position. Generator is ready to start. Right-hand sketch shows hookup to use when main switch is a 3-pole type. Extra switch should then be double-pole double-throw with midpoints across the shunt field of each generator.

M Cox *Harrisburg, Ill.*

SIMPLE LADDER DESIGN SIMPLIFIES GENERATOR CLEANING



AFTER REMOVING the rotating field and spider from our vertical waterwheel generators a scaffold is laid across the opening in the frame for cleaning and inspecting the stator coils. We had used a short stepladder but found it awkward to secure in place safely without damaging the stator coils. Another means had to be found to gain access to the points of work.

The access ladder, in sketch at left, was then designed and found easy to put in place and safe to use. The hooks are shaped from $\frac{3}{8}$x1$\frac{1}{2}$-in. flat iron. Their width at the free ends has been tapered so they fit into the air slots in the generator armature laminations.

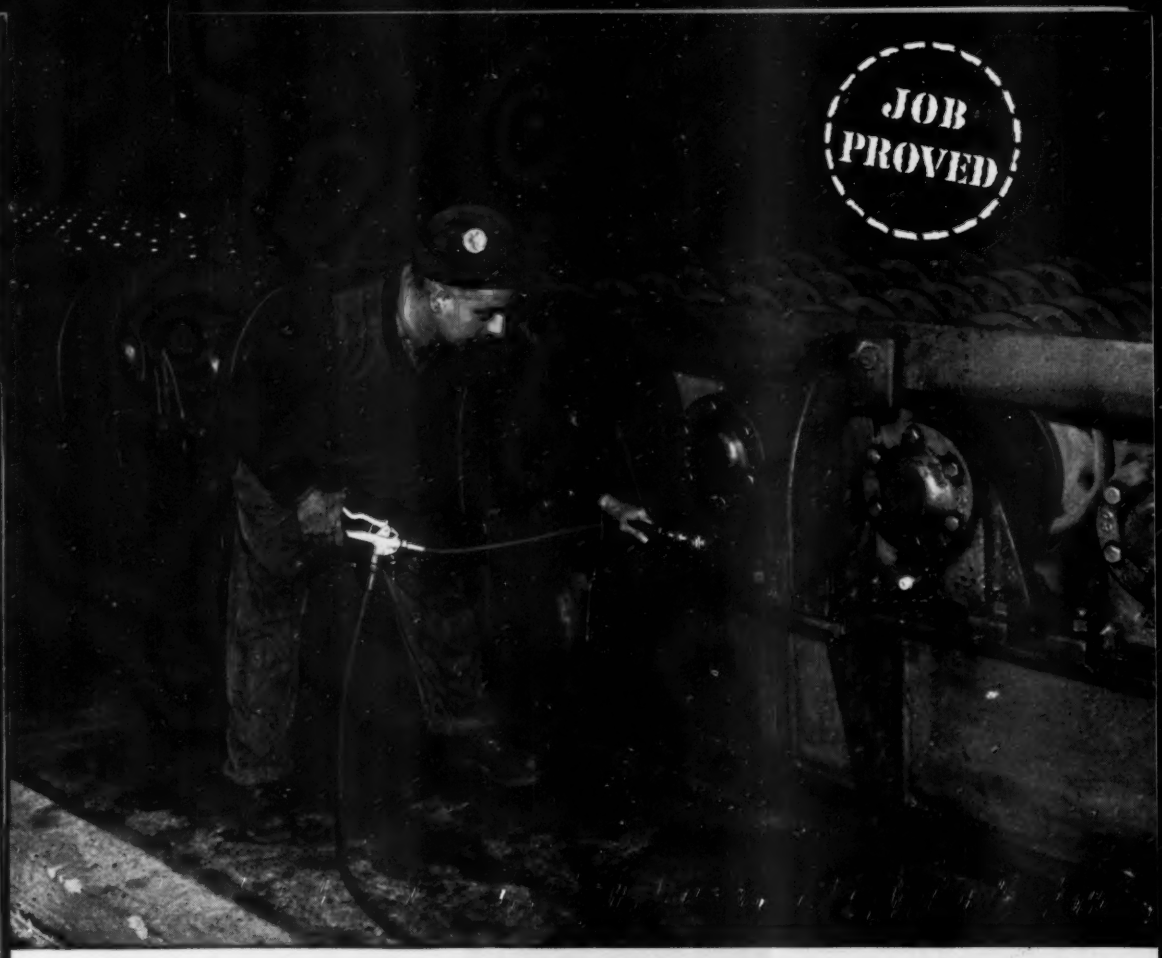
Hook shoulders carry all the load, hence the weight of the ladder causes it to lean against the base of the frame as shown. No extra stays are needed to keep the ladder in place.

T E MILLER *St. Elmo, Tenn.*

(Continued on page 128)

The Editors Invite Contributions From POWER Readers

Here's your chance to cash in on one of those professional tricks you have used in your plant. POWER pays $20 for each item published here on problems in design, operation and maintenance. Your contribution need be in rough form only —just set down all facts with sketches in pencil. We will do any editing that is needed.



BEARING FAILURES DOWN... STEEL PRODUCTION UP

Sun Grease Increases Production by Cutting Bearing Failures 92%

Burned-out table roll bearings were causing loss of valuable production-time in a steel mill. The failures—as many as five a week—were due to the grease melting and running out as a result of heat reflected from the steel plates. Each bearing-replacement cost $80, not counting labor cost.

A Sun Engineer who was called in recommended a high-melting-point grease that had proved its ability under similar conditions.

With this Sun lubricant on the job, 92 percent of the bearing failures have been eliminated. A cash saving of about $18,000 a year has resulted, and additional economies have been realized from greater production, power savings, and lower grease costs.

Sun "Job Proved" lubricants are helping to increase production, and to cut maintenance costs, in every kind of industry. What they do for others, they can do for you. For full information, call or write your nearest Sun Office.

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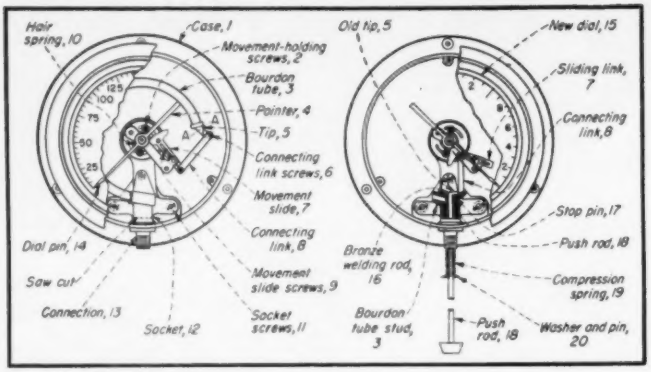
SUNOCO

 (*Continued from page 126*)



PRESSURE GAGE CONVERTS TO VIBRATION METER

THE ENGINEERING LABORATORY of the Jacksonville, Fla. municipal utility system made a meter for measuring vibrations of high displacement and low frequency from a salvaged bourdon-tube pressure gage. The instrument was needed to survey vibrations in the uptake flue ducts at the Talleyrand power plant. Available vibrometers would not measure the amplitudes involved.

The hand, dial and socket screws *11*, Fig. 1, were removed to allow taking out all the gage parts from the phenol case. Connecting link *8* was unscrewed to take off the complete movement from its base on the socket.

A horizontal cut was made halfway through the socket *12*. The bourdon tube was completely sawed off the socket after which a vertical cut through the socket was made to meet the horizontal one, Fig. 2. The L-shaped top-movement bearing plate was removed to reverse the movement slide *7*, Fig. 1, after which the plate was replaced. This completed the changes in the gage movement.

Bourdon-tube tip *5* was cut off at *A-A*, Fig. 1, and brazed on the end of a 3/16-in. bronze welding rod, 8-in. long, *16*—Fig. 2. A hole was drilled and reamed through the socket to fit the push rod *18*. A washer and pin holds in place the light compression spring *19*. Movement was then replaced and the connecting link *8* was replaced as shown in Fig. 2. All the parts were then assembled in the gage case.

By adjusting the sliding link *7* the gage pointer can be made to cover the entire range of the original dial for 0.3-in. movement of the push rod. A new dial was marked and calibrated.

E DALTON WHITE *Atlanta, Ga.*

MULTIPLE ORIFICES FOR DRAINING REDUCE MAINTENANCE

OUR HIGH-PRESSURE HEATERS had been drained through a loop system that at times did not operate satisfactorily. The heaters occasionally flooded, and the drain piping had to be renewed frequently because of the erosion caused by the high-pressure condensate and steam. Other automatic means were tried to drain these heaters to a covered makeup tank under atmospheric pressure, but none proved satisfactory.

We then installed orifices in series in the drain line as shown at right. These act the same as a labyrinth seal on a turbine shaft, reducing steam pressure in steps. This arrangement helps reduce steam flow and velocity, resulting in decreased erosion and noise. The orifices have operated over a year with practically no piping maintenance.

An orifice has a self-regulating characteristic that allows it to pass a large flow of water, but only a small flow of steam. A given orifice passing 1000 lb per hr of water under 400 psia will pass only about 50 lb per hr of steam under the same initial pressure.

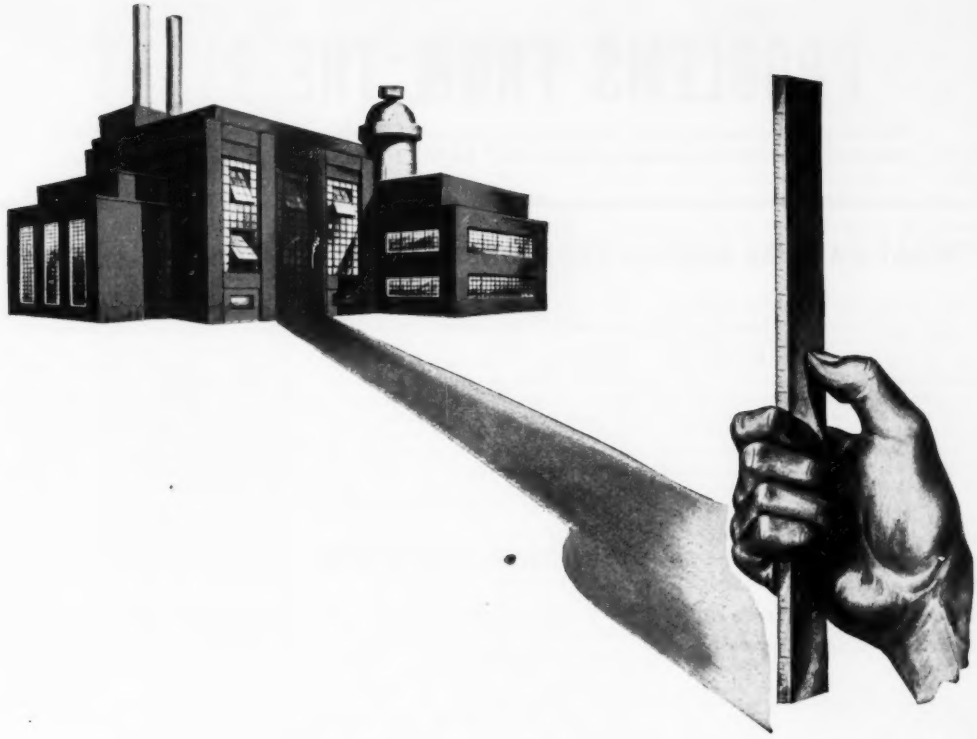
We sized our orifices by arbitrarily assuming that each one would reduce condensate pressure by 50%. For our 400-psia pressure this indicated need of five orifices. Areas of each opening were then based on the flow formula

$Q = 0.61A\sqrt{2gh}$. Design flow was 6250 lb per hr. This gave successive orifice diameters of 0.23, 0.27, 0.32, 0.38 and 0.45 in.

M E MARSHALL *Sea Cliff, N. Y.*

Editor's Note: It appears that Mr Marshall should have sized his orifices on the basis of steam-pressure drop rather than on basis of condensate flow. The first orifice probably produces most of the pressure drop from 400 psia to atmospheric when condensate flows. On this basis, area of the first orifice is about 30% too big since it is figured for only half the pressure drop. On the other hand, at saturated temperature, 25% of the condensate flashes into steam when reduced to atmospheric pressure. This means that a mixture of steam and water flows through the last four orifices and hence the pressures will be at some value above atmospheric, ahead of them but not successively halved as figured.

When only steam flows through the orifices, most of the pressure drop will take place across the last orifice with the areas provided, producing an undesirable high exit velocity. To halve the pressures successively after each orifice, the openings should be in the ratio of $(1/16):(1/8):(1/4):(1/2):1$.



How Well Does *Your* Boiler Plant Measure Up?

The effectiveness of your water conditioning can well be the yardstick of your boiler plant operation. How much *or how little* boiler water trouble you have is a true measure of successful, economical boiler plant operation. Consider then, "How well does *your* boiler plant measure up?"

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PROBLEMS FROM THE PLANT

Exercise your engineering wits by submitting answers to this question, fresh from the plant. Suitable material will be paid for; answers accompanied by sketches or photographs command additional pay

WHAT DAMAGE RESULTS FROM UNBALANCED GENERATOR LOADING?

ON A RECENT TRIP through our plant I noticed a seriously-unbalanced-load condition on one of our turbine-generators. The unit is rated at 1500 kw, 1875 kva, 3600 rpm, 2400 v and 60 cycles.

Load unbalance showed up on the switchboard ammeters; two phases had a load of about 500 amp, while the third carried 300. Machine nameplate showed the unit was rated for 451 amp per terminal.

Our chief electrician, who was on hand at the time, mentioned that the unbalanced-load condition was perfectly OK and assured us no damage could result. The operating engineer took quite another stand. He felt anything in excess of a 10% unbalance might damage the generator. Moreover, he regarded the unbalanced condition as most critical, and recommended installation of differential relays to trip off the machine if the unbalance should rise to 10 or 15%.

Incidentally, these periods of unbalance are not momentary, but are maintained for hours and many times for days on end. In view of this I feel the operating engineer was taking the proper stand. No doubt many POWER readers have definite ideas on this subject so I would certainly appreciate getting their slant. What is likely to happen if this unbalance is allowed to continue? How long will the machine stand such periods of unbalance?—*AE*

READERS' ANSWERS

How Can We Remove Turbine-Blade Deposit?

(This question is from February issue with best answers from readers.)

We are planning to install a new 2000-kw steam turbine in our plant, and want to organize maintenance procedure well in advance of actual operation. New unit is designed to operate at 600 psig, 825 F. It will exhaust to a condenser at 2-in. of mercury (absolute backpressure).

Preliminary water tests show extensive treatment will be needed for water makeup, and hence frequent removal of chemical deposits is anticipated.

We would appreciate hearing of practical methods now being used by POWER *readers to remove deposits from turbine blades, nozzles and valves. Desuperheater piping details, washing procedure, and tests to tell when the job is finished would be of great help.*—ME

Kerosene Oil Will Help

APPARENTLY, STEAM INPUT to *ME*'s turbine is superheated. With poor water, one of the main problems will be to keep the superheater tubes from becoming fouled by scale and foreign materials. A good steam separator should precede the superheater which, incidentally, will assist materially in keeping blades of turbine from suffering too badly.

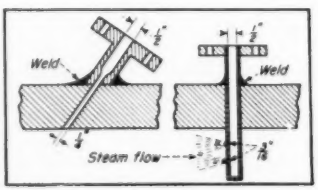
Turbine blades can be kept in good operating condition by injecting approximately one gallon of kerosene oil into the turbine inlet about every four weeks and, if necessary, scraping the blades during the annual overhaul. With good feedwater treatment and a proper steam separator very little material will be deposited on turbine blades.

J C NUTTER *Toronto, Canada*

Procedure Outlined

METHOD OF CLEANING depends on type of scale adhering to blades. If scale is soluble, it is easy to wash blading with saturated steam. Where scale cannot be washed off it is necessary to sandblast with fine sand or flyash. Following procedure is recommended for washing scale off turbine blades without dismantling unit.

Decrease turbine load to approximately half rated load. Some engineers may recommend ¼ load on unit. Of course, smaller load means a longer washing period because of the reduction in steam flow and hence in the amount of water going through turbine. Remember that washing puts severe strain on a turbine. If it is not done carefully under competent supervision, distortion of various parts can cause serious damage. *ME* should listen for any unusual noises during washing, and be prepared to shut unit down if anything out of the ordinary occurs.



Connection from boiler-feed line should be installed approximately 50 ft in front of throttle. The nozzle, or nozzles, should enter main header so as to direct spray of water against steam flow. Sketch below shows two typical nozzles. Next step is to install a quick-response thermometer in steam line adjacent to throttle valve. The following outline is a good procedure for handling the job.

1. Close header valve slowly to throttle steam-supply pressure until desired washing load is on turbine with the steam inlet or control valves wide open. This lowering of pressure should take from 10 to 45 min, depending on unit size. Figure 10 min for a 2000-kw turbine, and 45 min for a 60,000-kw unit.

2. Open all drains in turbine cylinder, throttle valve, extraction openings, etc.

3. Slowly crack regulating valve in water line (desuperheating line) to the main steam header. Watch temperature closely and admit only enough water to bring it down approximately 70 F per hour. Close valve when temperature at throttle shows 10-F superheat for the corresponding pressure. You can tell how much water is entering the turbine by amount dripping from drains.

Operate at this temperature for about two hours, sampling discharge from various turbine drains in addition to

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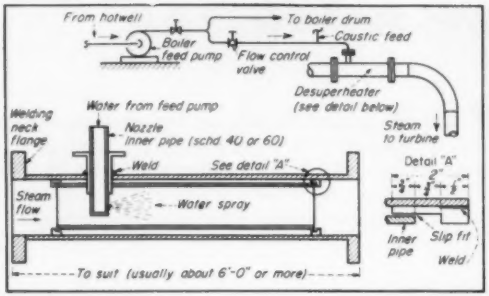

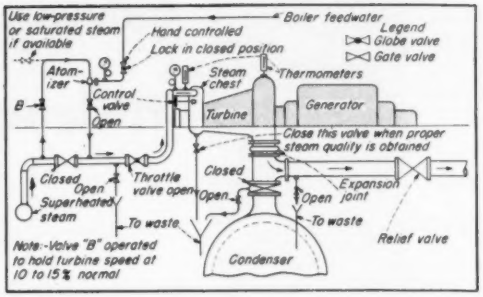

checking the condensate. Normally, you will be able to tell completeness of wash just by noting the clearness of discharge. If *ME* wants to go farther he can check amount of solids in discharge with a conductivity cell. The eye test is usually sufficient.

4. Slowly shut off water from desuperheating line to bring temperature of supply steam back to normal at about 70 F per hour.

5. Bring steam pressure slowly back to normal using the same time interval as used in lowering pressure. When drains begin to blow too hard, throttle them slightly, but do not close.

6. Close all drains after there is no further sign of moisture at drain openings.

7. Bring load back to desired level gradually, and check stage pressures. These pressures should be checked before and after washings as they give a good indication of the success of the wash. When checking stage pressures be sure throttle pressure and load on turbine are identical each time.

F J HERZINS *Tyrone, Pa.*

Desuperheater Details

ME SHOULD GET a stage-pressure variation chart from turbine manufacturer to check stage-pressure readings at various loads. Where there is a variation between chart and actual stage pressures, the turbine blades and nozzles are fouled.

Best cleaning method depends on type of deposit. Use wet steam and caustic, or just wet steam for soft deposits. To apply: (1) reduce turbine speed to about 25% normal (2) supply feedwater to nozzle in steam main ahead of turbine or into steam chest (3) increase feedwater flow until steam temperature decrease is 90 to 100 F per hour (4) continue feed until steam is about 4% moist (5) measure condensate conductivity. Change in conductivity indicates when cleaning is complete.

After cleaning is finished, decrease feedwater flow until steam temperature rises 90 to 100 F per hour. When normal temperature is reached, put turbine back on line.

For hard, scaly deposits use air blast alone, or air blast with special abrasives or flyash. Accurate fouling-rate record is best guide to cleaning frequency when water conditions do not vary.

Sketch above left shows typical desuperheater piping and details. Internal pipe takes bulk of corrosion load. *ME* can build desuperheater himself, or have contractor do it.

Where cleaning fluid is introduced into turbine steam chest, builder usually supplies nozzle. Hence *ME* need only connect feedwater piping.

TYLER G HICKS *New York, N. Y.*

Typical Piping Layout

IF *ME* INTENDS to wash down the turbine to remove blade deposit he should use saturated steam if it is available. Next best thing is an atomizer or steam-and-water mixer on his superheated steam. The turbine manufacturer should design and furnish the atomizer so the orifice is correctly sized for the conditions under which it will be used. Washing down is an exacting job, which should be done only by an experienced operator.

If *ME* will contact his manufacturer about his operating conditions the manufacturer will undoubtedly supply him with the exact details of the wash-down procedure. Most turbine manufacturers prefer to outline the procedure for the proper care of their machines. It is to their advantage to do so.

Sketch above shows a suggested piping diagram for the hookup, using an atomizer and superheated steam for wash-down. Atomizer is supplied from boiler feedwater line. This setup desuperheats the steam for use in the wash-down. Boiler feedwater has the required pressure; hence, it will not cool the steam excessively. Since feedwater has already been processed it should be relatively free from impurities. Bleed valves should be installed, enabling operator to check quality of steam when washing down.

Since the turbine is exhausting to a condenser some provision should be made to blank off the condenser; otherwise, all turbine scale will be carried into it. If this is not possible clean the condenser thoroughly after each wash-down. If a blank-off valve is placed between the turbine exhaust and the condenser inlet, below the atmospheric exhaust connection, it will be possible to discharge through the atmospheric relief piping during wash-down. By providing drain valves in this line and allowing them to discharge into open funnels with a shutoff valve in each drain, the discharge can be observed. Open funnels should be fitted to permit taking samples of discharge. They can be analyzed to determine amount of impurities present, thus allowing operator to tell when wash-down is complete.

It is important to obtain from the manufacturer proper turbine speed during wash-down. *ME* should also provide sufficient pressure gages and thermometers so the right temperature and pressure can be maintained throughout washing operation. If turbine has any bleedoff lines they should be fitted with drains at the low points between turbine and first shutoff valve.

Even though wash-down is used to clean turbine blades, a periodic shutdown for a more thorough cleaning will be necessary although it is not needed quite as often.

SHELDON R HIGGINS
Long Beach, Calif.

Fill Case With Solution

ME PRESENTS A PROBLEM that has many variables. It may be solved in a number of ways and at several points in the power-plant cycle. First consideration in carryover deposits is identification of

(*Continued on page* 176)

Your answer to Tube Dezincification–

ANACONDA ARSENICAL ADMIRALTY 439

ANACONDA began commercial production of Arsenical Admiralty Condenser Tubes in 1934—after two years of intensive research work. Tests had proved that a small percentage (0.04) of arsenic added to Admiralty Alloy materially increased its resistance to dezincification.

Since 1934, this improved alloy has performed outstandingly in almost every kind of service. Arsenical Admiralty Alloy 439 offers high heat transference as well as high resistance to general corrosion. It costs the same as plain Admiralty.

There are 8 standard and several special Anaconda Alloys for condenser and heat exchanger tubes. You are invited to consult our Technical Department in determining the most suitable alloy for your use. For general information on Anaconda Tubes and Tube Sheets, send for our Publication B-2.

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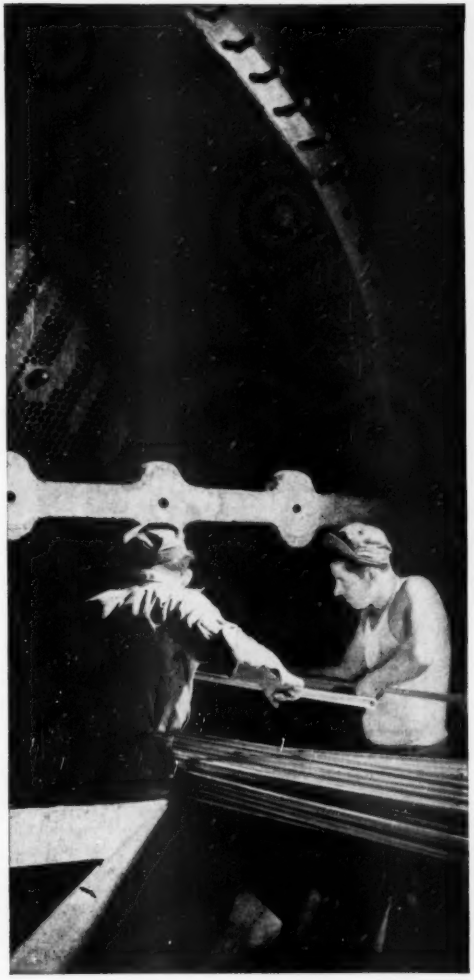


Retubing with Arsenical Admiralty to Serve a New England Industrial Area

Arsenical Admiralty 439 Tubes were chosen for this recent retubing job, to combat the corrosive effects of a combination fresh and salt water coolant. The 2-pass condenser has a 29,000 sq. ft. cooling surface and serves a 25,000 kw generator. 5,600 tubes, with a weight of 65,000 lb. will go into the condenser. Utility station supplies power to an important New England industrial area.

TECHNICAL BRIEFS

ENGINEERING DEVELOPMENT HERE AND ABROAD DIGESTED FOR BUSY POWER MEN

REVIEWED IN THIS ISSUE

COMMUTATION

Commutation of Dc Machines and Its Effect on Radio

The Effects of Film Surfaces on Commutator Action

Oscillographing Commutation

CIRCUIT PROTECTION

Reactors Raise Fault Capacity

Air-Core Reactors Serve As Limiting Means

Medium Voltage Oilless Circuit-Breakers

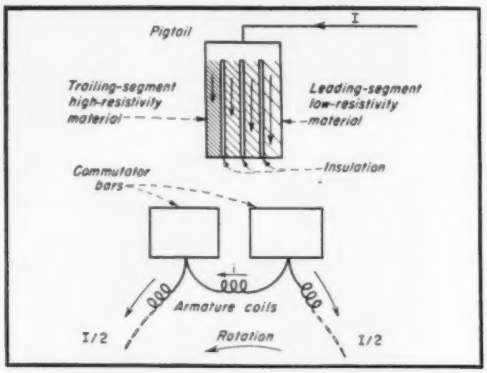
WATER TREATMENT

Hydrogen Embrittlement

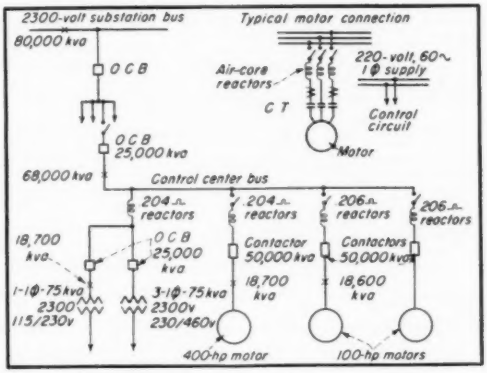
MEASURING GAS

Errors in High Temperature Probes

Directions for ordering papers are given on page 136



1 New laminated brushes produce division of current during commutation by an increased resistance of each lamination



2 Diagram of typical system, above, employing air-core reactors as described below reports increased fault capacity

COMMUTATION

COMMUTATION OF DC MACHINES AND ITS EFFECTS ON RADIO-INFLUENCE VOLTAGE GENERATION, *by D P Motter, General Electric Co.* It is general knowledge that radio-influence voltage is generated when a direct current passes from a stationary surface, such as a brush, to a rotating surface, like a slipring. To study these phenomena, tests were made on a generator, as a result of which laminated brushes were developed that improve commutation and reduce radio-influence voltage generation over a wide range of armature current.

With the new laminated brushes current commutation in an armature coil depends largely on the increase in resistance of each brush lamination as the commutator bar progresses from the leading to the trailing edge of the brush. The thickness of each lamination in the brushes used on the test machine was equal to or less than the thickness of insulation between two adjacent commutator bars. Each brush lamination is insulated from all others as well as from the brush holder, except at the pigtail end of the brush, as in the figure.

As a result of this design, the circulating current across the brush face must flow through the entire length of two brush laminations whose combined resistance is considerably larger than the resistance across the face of a solid brush, or of a laminated brush without insulation between laminations. Therefore, the circulating currents are reduced early in the commutation period, thereby promoting greater control of coil-current reversal by the brushes. A relative division of current through the brush laminations is represented by the length of the arrows on each lamination in the figure. This more or less forced division of current is conducive to a more constant coil-current reversal. The author comes to these conclusions:

1. One of the main causes of radio-influence voltage generation in dc rotating machinery is transient voltages produced during commutation.

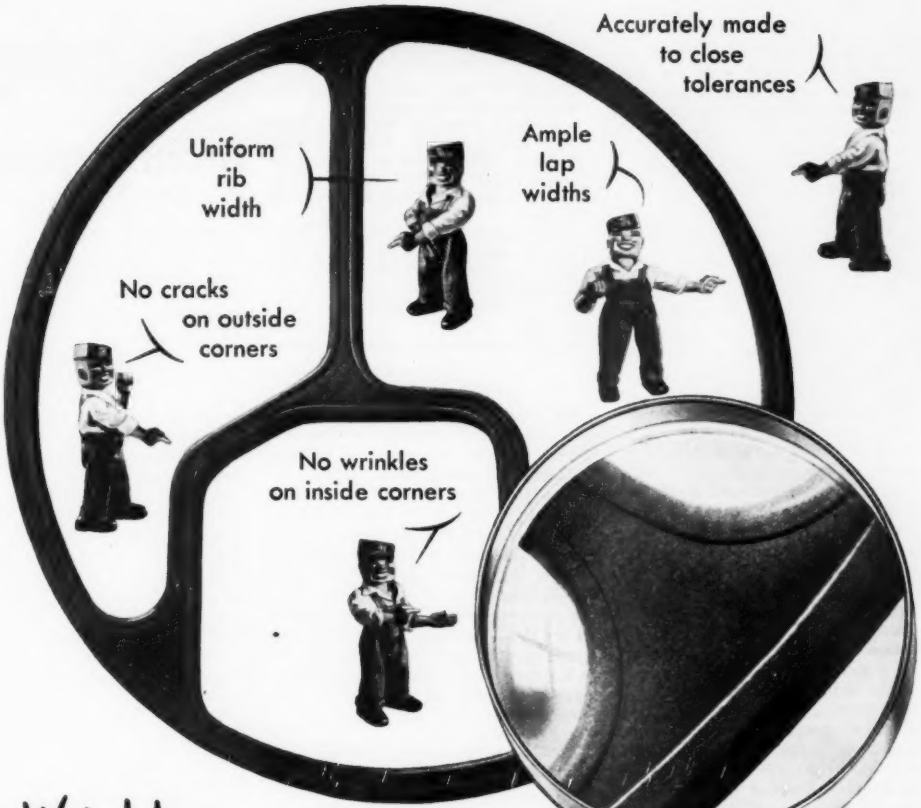
2. Magnitude of the transient and of the radio-influence voltage generated depends on linearity of armature-coil current reversal.

3. Black-band commutation is no assurance of the best quality of commutation to reduce radio-influence voltage generation.

4. Where interpoles are not used, there is an armature current at which commutation is better and minimum radio-influence voltage is generated when using standard brushes.

5. Laminated brushes can improve armature-coil current reversal and provide an appreciable reduction of radio-influence voltage, generated over a rather wide range of armature current. *AIEE Paper No. 49-28.*

EFFECTS OF COMMUTATOR-SURFACE FILM CONDITIONS ON COMMUTATION, *by C Lynn and H M Elsey, Westinghouse Electric Corp.* Copper is universally used for the bars in commutators because it is relatively cheap, fairly strong, does not draw beads on arcing, and because in uncontaminated atmospheres it forms a film on its surface that assists commutation. Until recent years, the important part played by this film surface was not fully appreciated. In the old days the best operating dc machines had chocolate-colored commutators. This was when machines had low ratings, operated at


Accurately made to close tolerances
Uniform rib width
Ample lap widths
No cracks on outside corners
No wrinkles on inside corners

No Wrinkles... No Cracks... No Blowouts!

no place for leaks in THIS heat exchanger gasket

TAKE A CLOSE LOOK at the Goetze heat exchanger gasket shown above. Note the absence of cracks on outside corners . . . of wrinkles on inside corners . . . the uniform width of the ribs . . . the generous overlap of the metal jacket.

Attention to such important details is typical of the kind of care that goes into the forming of these custom-made gaskets. It is the secret of their dependable service—why you can count on them to stay on the job indefinitely without leaks or blowouts. And it's the reason they pay off in terms of less down-time and in the savings that result when gaskets *don't* have to be replaced at frequent intervals.

• • •

You can have Goetze heat exchanger gaskets made in any size or shape. Estimates and recommendations will be furnished promptly on request. Write Johns-Manville, Box 290, New York 16, N. Y.

JOHNS MANVILLE JM PRODUCTS

Johns-Manville *Goetze* Gaskets

slow speeds, and had relatively easy load cycles. There were few brush grades, no treated brushes, and much less was known about brushes and commutator-surface films. This paper discusses the effects on commutation produced by surface films of various types, and other factors involved in the commutating problem.

With the introduction of electrographitic brushes and large high-speed dc machines with more difficult load cycles and more contamination of atmospheres in industrial plants, commutator surfaces of unfamiliar types and colors developed. With newer grades of electro-graphitic brushes, commutators with black surfaces began to develop in certain steel-mill applications. Peculiar-colored commutator surfaces occurred in chemical industrial plants and paper mills.

Most machines with black commutators operated successfully, but the customer objected to the color. Cleaning or scouring brushes were brought out about this time. These brushes mechanically abraded the commutator surface to reduce the discolored film. Amount of scouring action was controlled by the number of brushes used on a given track.

The authors expressed the opinion that scouring brushes have no place on electrical machines properly designed and built, loaded within their rating and fitted with correct brushes not operated under abnormal atmospheric conditions. If any of these factors is ignored, cleaner brushes may be the economical way to remove mechanically the carbon soot laid down by the brushes because of their poor quality or from their abuse by an improperly designed or built machine, or by one subjected to adverse loading or operating conditions. Cleaner brushes may also remove the undesirable films produced by hydrogen sulphide or other gases in the air. In many contaminated industrial atmospheres the use of cleaner brushes is not economical because they rapidly wear the commutator.

The authors reached the conclusion that commutator-surface film conditions exert a large influence on the commutation of a dc machine. Duplicate machines of the same design, built on the same order in the factory, each successfully passing the manufacturer's test, may be entirely different in performance in the field. While loading conditions may have a pronounced effect, frequently the variable performance is caused by the atmosphere in which the machines operate.

Relatively little is known of surface films produced on commutators during operation under adverse conditions. The detrimental effects produced are recognized, but complete solutions for these troubles are not yet available. Machines operating under such conditions frequently have to be nursed along by using scouring brushes, grinding the commutator or using ventilation. The problem has also been attacked with brushes designed or chemically treated to react with the film, at times supplying something missing from the atmosphere, or producing a reaction that permits the brushes to ride the film successfully to produce passable commutation. *AIEE Paper No. 49-29.*

TO OBTAIN COMPLETE TEXT

Material for these abstracts came from one of the following sources:

American Society of Mechanical Engineers annual meeting, New York, Nov 29-Dec 3, 1948. Papers are identified by initials ASME and paper number. Available at ASME, 29 W 39th St, New York 18, N. Y.

American Institute of Electrical Engineers winter meeting, New York, Jan 31-Feb 4, 1949. Papers are identified by initials AIEE and paper numbers. Available at AIEE, 33 W 39th St, New York 18, N. Y.

OSCILLOGRAPHING COMMUTATION, *by M J Baldwin, General Electric Co.* Textbooks have long contained theoretical explanations of commutation, but we have lacked the necessary tools to obtain actual pictures indicating instantaneous values of current and voltage in coils undergoing this transition. The cathode-ray oscilloscope is the fundamental tool that now makes this possible. One method of obtaining such pictures is described in this paper, illustrated with typical oscillograms. The latter bear out in general the classical textbook material rather closely and, in addition, the test curves are convincingly realistic in that they are far from smooth.

This investigation was undertaken for a better understanding of commutation, with the hope that the added knowledge might serve to point the way to improvements that would extend the range of applications of dc rotating apparatus.

These curves indicate clearly the entire problem of commutation. Effects of variation in commutating-pole adjustment and of mutual inductance upon rate of current change are shown. The difficulty of getting several coils in a slot to commutate equally is revealed. The need for brushes to absorb residual voltage under the best of conditions is suggested. Commutation theory is proved correct, and a better understanding of commutation is promoted. *AIEE Paper No. 49-27.*

CIRCUIT PROTECTION

AIR-CORE REACTORS USED TO RAISE THE FAULT CAPACITY OF EXISTING MOTOR-STARTING EQUIPMENT, *by T W Haynes, Jr, Shell Oil Co.* One of the problems facing the electrical engineer in many industrial plants has been the continued growth of the electrical system, caused by plant expansion increase in electricity use for manufacturing processes. The Wood River Refinery of the Shell Oil Co, which this paper deals with, is an example of an expanding industrial plant where load increase may cause trouble because of inadequate capacity of the existing switchgear.

During the war the 2300-v substation increased until it had a short-circuit capacity of 80,000 kva. Available short-circuit kva at the control center was calculated to be 58,000. The incoming-line circuit breaker at the center was rated 25,000-kva interrupting capacity, which was inadequate for this circuit. In addition to the incoming-line cubicle there was a feeder cubicle that contained two circuit breakers rated at 25,000 kva. Two other cubicles were motor starters for a 400-hp and a 100-hp induction motor. Their contactors were rated ten times the normal load rating or approximately 8000 kva for the 400-hp starters and 2000 kva for the 100-hp starters.

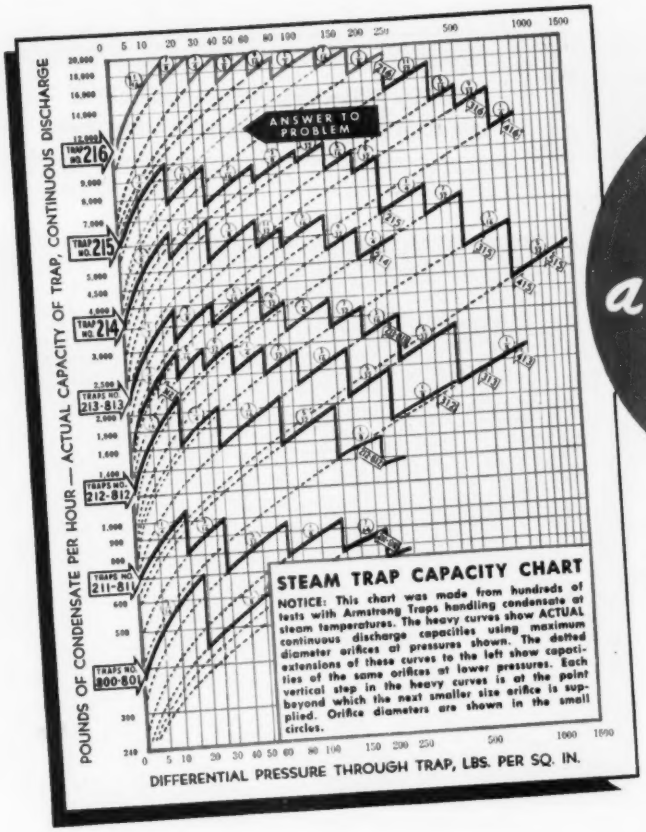
When studying the problem of correcting the inadequate interrupting capacity at this plant several alternatives were considered.

1. Replace the entire unit with switchgear of adequate capacity.

2. Place a reactor in the feeder to the unit to reduce the short-circuit power to a value within the equipment's rating. *AIEE Paper No. 49-116.*

USE OF AIR-CORE REACTORS AS FAULT-LIMITING MEANS ON HIGH-INTERRUPTING-CAPACITY CONTROLLERS, *by John D Leitch, Electric Controller & Mfg. Co.* For many years it has been general practice to install motor controllers with moderate interrupting capacity (ten times their rating) in branch circuits without regard to the available fault kva at the point of installation. It was considered adequate to provide protection for these and other branch circuits with a back-up breaker. When a fault occurs the controller opens before the breaker. It often fails to clear the circuit, thus requiring operation of the breaker, but not before considerable damage has been done.

(Continued on page 158)


ANSWER TO PROBLEM
TRAP NO. 216
TRAP NO. 215
TRAP NO. 214
TRAPS NO. 213-813
TRAPS NO. 212-812
TRAPS NO. 211-811
TRAPS NO. 800-801
POUNDS OF CONDENSATE PER HOUR — ACTUAL CAPACITY OF TRAP, CONTINUOUS DISCHARGE
DIFFERENTIAL PRESSURE THROUGH TRAP, LBS. PER SQ. IN.
STEAM TRAP CAPACITY CHART
NOTICE: This chart was made from hundreds of tests with Armstrong Traps handling condensate at steam temperatures. The heavy curves show ACTUAL continuous discharge capacities using maximum diameter orifices at pressures shown. The dotted extensions of these curves to the left show capacities of the same orifices at lower pressures. Each vertical step in the heavy curves is at the point beyond which the next smaller size orifice is supplied. Orifice diameters are shown in the small circles.

BECAUSE good trapping starts with selection of the right trap for the job, Armstrong has provided all the data necessary for correct trap selection in the Armstrong Steam Trap Book. The Capacity Chart reproduced here is taken from this handy reference work. By means of this chart, any engineer can select the correct traps for his requirements. Here is a typical problem showing how the chart is used:

Given: An evaporator condensing 6000 lbs/hr at 50 psi when the steam is first turned on, but condensing only 1000 lbs/hr at 150 psi at the end of the process. Safety factor of 2 to 1 required at the *minimum* pressure differential.

Solution: Referring to the chart, the No. 216 Armstrong Trap with 7/16" orifice for 150 psi pressure has a capacity of 12,000 lbs/hr at 50 psi. This provides for the 2 to 1 safety factor and is, therefore, the correct trap for the job.

The Armstrong Steam Trap Book provides recommended safety factors for different services and handy tables to help you calculate condensing rates. Other useful data included are: hook-up diagrams; do's and don't's; trouble-shooting tips; prices and specifications. You're welcome to a copy. **ARMSTRONG MACHINE WORKS, 812 Maple Street, Three Rivers, Michigan.**

ARMSTRONG *Inverted Bucket* **STEAM TRAPS**

For fuel savings, low maintenance, automatic air removal ***SPECIFY ARMSTRONG!***

POWER NEWS

BUSINESS ITEMS • APPOINTMENTS • FOREIGN FIELDS
WASHINGTON NOTES • NEW DEVELOPMENTS • CONVENTIONS

Largest High-Speed Diesel Is Unveiled

► FURNISHING MORE POWER than any high-speed engine now in production, a V-12 4-cycle supercharged unit, rated 550 hp at 2100 rpm, was previewed by about 40 representatives of the technical press at the Columbus, Ind. plant of Cummins Engine Co, Inc. With laboratory tests and field trials in off-highway trucks of 30 and 40 tons payload,* a 5-cu-yd-shovel and 65-ton locomotives behind it, the new engine is now being produced for automotive, mobile-equipment, locomotive and stationary applications, with marine models expected to follow. This unit and its companion naturally aspirated model, rated at 400 hp, greatly extend the horsepower range of Cummins single-unit diesels, formerly available from 58 to 275 hp.

With its gear-driven positive-displacement supercharger and all standard accessories, the 550-hp model weighs 4550 lb and measures 73 in. long, 41 in. wide and 57 in. high. Its specific weight is 8.3 lb per hp. A feature of the new engine is its fuel-injection system. This follows the basic principles of the well-known Cummins distributor system, with a single pump metering the charge to all cylinders, but mechanical design has been highly refined to reduce size and weight of the equipment. Specifica-

(*Continued on page 202*)

Atomic Energy "Triggers" Cornerstone Laying

Something new was added to the tradition-bound business of cornerstone laying at the 19-story Crowell-Collier Publishing Building on New York's 5th Avenue. A nuclear reaction split 10 atoms of U-235, supplying power to cut the customary ribbon, set in action a hoist which lowered into place the 2-ton cornerstone (right), and ignite a magnesium flare. Dr. J R Dunning, Columbia University nuclear scientist who supervised the operation, said that, to his knowledge, it was the first time atomic energy was substituted for human hands and physical effort in such activity

COMING EVENTS

May 5-6—Pennsylvania Electric Assn, Prime Movers Committee meeting, William Penn Hotel, Pittsburgh, Pa. John W Mikels, chairman, 19 E Washington St, New Castle, Pa.

May 12-13—Instrument Society of America, fourth annual spring meeting, Royal York Hotel, Toronto, Canada. Ed Grace, Instrument Society of America, Pittsburgh 12, Pa.

May 23-27 — Smoke Prevention Assn of America, 42nd annual conference, Tutwiler Hotel, Birmingham, Ala. T W Langford, 1913 Fourth Ave N, Birmingham 3, Ala.

May 24-27—National District Heating Assn, 40th annual meeting, New Ocean House, Swampscott, Mass. John F Collins Jr, secretary-treasurer, 827 N Euclid Ave, Pittsburgh 6, Pa.

May 30-June 3 — American Water Works Assn, meeting, Hotel Stevens, Chicago. Arthur T Clark, Water and Sewage Works Mfrs Assn, New York 7.

June 2-4—Wisconsin Power Conference and Exposition, sponsored by Wisconsin State Assn, NAPE, and Associate Engineers and Supplymen of Wisconsin, Schroeder Hotel, Milwaukee, Wis.; Charles E Gelhaar, 2874 N Hartung Ave, Milwaukee 13.

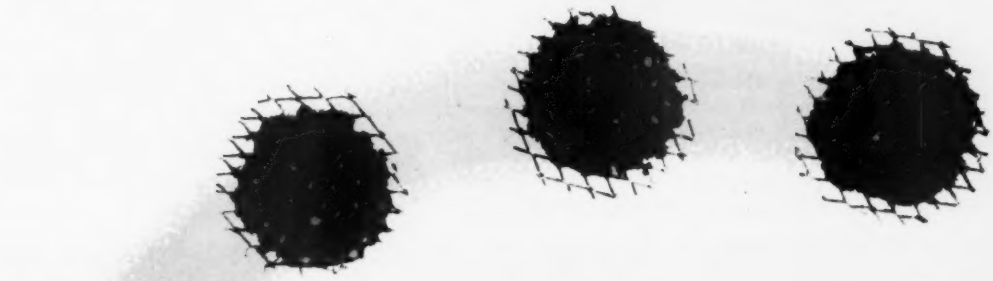
June 20-24—American Society for Engineering Education, annual meeting, Rensselaer Polytechnic Institute, Troy, N. Y.; O J Freund, president, University of Detroit, Detroit, Mich.

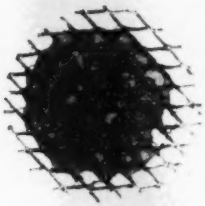
July 4-8—Gordon Research Conference on Ion Exchange, sponsored by the American Assn for the Advancement of Science, Colby Junior College, New London, N. H.; W George Parks, director, Rhode Island State College, Kingston, R. I. From June 15 to Sept 1 address mail to Colby Junior College.

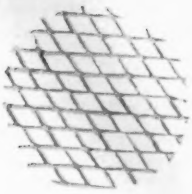
Sept. 12-16—Instrument Society of America, convention, Municipal Auditorium, St. Louis, Mo.; Richard Rimbach, secretary, 1117 Wolfendale St, Pittsburgh 12, Pa.

Sept 26-28 — National Electronics Conference, meeting and exhibit, Edgewater Beach Hotel, Chicago, Ill.; Karl Kramer, secretary, Jensen Mfg Co, Chicago.

DO *Nalco* SOOT REMOVERS REMOVE **SLAG?**







EVER since Nalco Soot Removers *(the soot removers that remove soot)* were made available to industry, a continuing flood of inquiries has been coming in —"Will Nalco Soot Removers remove slag?" Here is the answer, as completely as Nalco Laboratory testing and research, and the reports of Nalco Field Representatives give it:

Where slagging occurs in boiler furnaces using Nalco Soot Removers, the experience *on most types of slag* has been that specific gravities of slags are lowered from 2.2-2.7 to 0.6-0.7. This action appears to make the slags spongy and friable, so that they can be more easily removed. In some plants the slag actually falls away, giving the appearance — and effect — of complete removal. Several plants with virtually no soot removal problem are now using Nalco Soot Removers specifically for their effect on slagging conditions.

However, in original announcements of Nalco Soot Removers, and in subsequent reports, no representation has been made that Nalco SR Series Chemicals are slag removers. Nalco research has been underway for nearly four years on the problem of slag removal, and most recent reports indicate that a product comparable to the Nalco Soot Removers is not yet ready.

If you have slagging in your furnaces and wish to check the effect of Nalco SR Chemicals, we recommend that you write us or contact your Nalco Representative. It is possible that Nalco Soot Removers can be of help to you in alleviating slagging, pending perfection of a Slag Remover worthy of being labeled A Nalco Product.

NATIONAL ALUMINATE CORPORATION
6222 West 66th Place • Chicago 38, Illinois
Canadian inquiries should be addressed to
Alchem, Limited, Burlington, Ontario

THE *Nalco* SYSTEM . . . Serving Industry through Practical Applied Science

How to plan a

CONTINUOUS BOILER BLOWDOWN SYSTEM

Another in the series of basic piping layouts prepared by Jenkins Bros.

To remove troublesome solids, a continuous boiler blowdown system of the type illustrated is commonly used on power boilers. Constant foaming and priming of boilers, which cause excess moisture in the steam discharge from the boiler, result from high concentration of dissolved or suspended solids prevalent in the boiler water. These solids enter with the makeup water and become concentrated, since they do not pass off with the steam. Some method of boiler blowdown is required to rid the boiler of the troublesome solids to avoid unsatisfactory boiler operation and rapid deterioration of boiler tubes.

The continuous blowdown system shown has the advantage of keeping solids concentration at a uniformly low level and also of utilizing practically all the heat contained in the blowdown discharge. Heat from the blowdown is recovered in two ways. The high pressure, high temperature water drawn from the boiler drum during blowdown enters a flash tank which is maintained at a low pressure. The reduction of pressure causes some of the water to flash into steam which goes into the deaerating feedwater heater where it mixes with the plant condensate returns and the makeup water.

Jenkins PRACTICAL PIPING LAYOUTS

Illustrating the proved 3-point formula for trouble-free, time-defying hookups

A Use the right type valve for the service.
B Place valves correctly in the line.
C Choose Jenkins Valves for lifetime economy.

44

Fig. 370
BRONZE
GATE VALVE
Solid Wedge
Stationary Spindle

For steam, water, oil and gas lines where full, unobstructed flow is required. In rapidly vibrating currents especially, the solid wedge offers maximum resistance to pressure strains, lengthening service life. When valve is fully open, the wedge entirely clears the pathway, affording flow practically equal to that of the pipe.

The water remaining in the flash tank contains the undesirable solids and must be drained off. This water, still containing much heat, is passed through the heat exchanger where the heat is extracted and passed on to the makeup water entering the feedwater heater. The water level in the flash tank is controlled by a float control. An emergency alarm is also used to warn the plant operator if the level in the flash tank rises too high, indicating inadequate drainage.

The remaining solids collect on the tubes and must be periodically removed. This is accomplished by the makeup water in the washing system shown.

This system can be adapted to boilers of any pressure rating, but the valves used on the blowdown lines from the boiler must always be of the corresponding boiler rating. The Jenkins valves recommended here are for a 300 lb. boiler. Selection can be made for other pressures from the complete Jenkins line. Consultation with accredited engineers and contractors is recommended when planning major piping installation.

Jenkins Bros., 80 White Street, New York 13; Bridgeport, Conn.; Atlanta; Boston; Philadelphia; Chicago; San Francisco.
Jenkins Bros., Ltd., Montreal.

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B	3	Fig. 976 A Bronze Globe	Control Blowoff to Blowoff Header

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CONTINUOUS BOILER BLOWDOWN SYSTEM

CONTINUOUS BOILER BLOWDOWN SYSTEM

CODE	Quan.	Jenkins Valve	Service
A	3	Fig. 280 Bronze Gate	Shutoff Boiler Drum Connections to Blowoff Header
B	3	Fig. 976 A Bronze Globe	Control Blowoff to Blowoff Header
C	3	Fig. 976 A Bronze Globe	Sample Boiler Water Shutoff
D	1	Fig. 280 Bronze Gate	Shutoff Feed to Flash Tank
E	1	Fig. 92 Bronze Swing Check	Prevent Backflow to Flash Tank from Heat Exchanger
F	1	Fig. 47 Bronze Gate	Shutoff Liquid Discharge from Flash Tank
G	2	Fig. 47 Bronze Gate	Shutoff Condensate to Heat Exchanger
H	1	Fig. 47 Bronze Gate	Bypass Heat Exchanger
J	2	Fig. 370 Bronze Gate	Shutoff Float Control Valve
K	1	Fig. 106 A Bronze Globe	Float Controlled Valve Bypass
L	1	Fig. 92 Bronze Swing Check	Prevent Contamination of Make-up Water
M	1	Fig. 106A Bronze Globe	Manual Periodic Washing of Heat Exchanger
N	2	Fig. 47 Bronze Gate	Make-up Water to Heat Exchanger
O	1	Fig. 47 Bronze Gate	Heat Exchanger Bypass of Make-up Water
P	2	Fig. 370 Bronze Gate	Float Controlled Valve Shutoff
Q	1	Fig. 106A Bronze Globe	Float Controlled Valve Bypass
R	1	Fig. 92 Bronze Swing Check	Prevent Backflow
S	2	Fig. 651 I B B M. Gate	Steam to Feedwater Heater
T	2	Fig. 280 Bronze Gate	Pressure Reducing Valve Shutoff
U	1	Fig. 976A Bronze Globe	Pressure Reducing Valve Bypass
V	1	Fig. 47 Bronze Gate	Low Pressure Condensate to Feedwater Heaters
W	1	Fig. 92 Bronze Swing Check	Prevent Backflow from Heater
X	1	Fig. 106A Bronze Globe	Vent Flow Control
Y	1	Fig. 47 Bronze Gate	Boiler Feed Pump Suction
Z	1	Fig. 962 Bronze Swing Check	Prevent Backflow to Pump
AA	1	Fig. 280 Bronze Gate	Boiler Feed Pump Discharge
BB	2	Fig. 106A Bronze Globe	Drain Valves
CC	1	Fig. 970 Bronze Globe	Blowoff Header Drain
DD	1	Fig. 962 Bronze Swing Check	Prevent Backflow to Blowoff Header
EE	4	Fig. 741 G Bronze Needle	Pressure Gauge Control

VALVE RECOMMENDATIONS
For details and valves to suit varying conditions see Jenkins Catalog

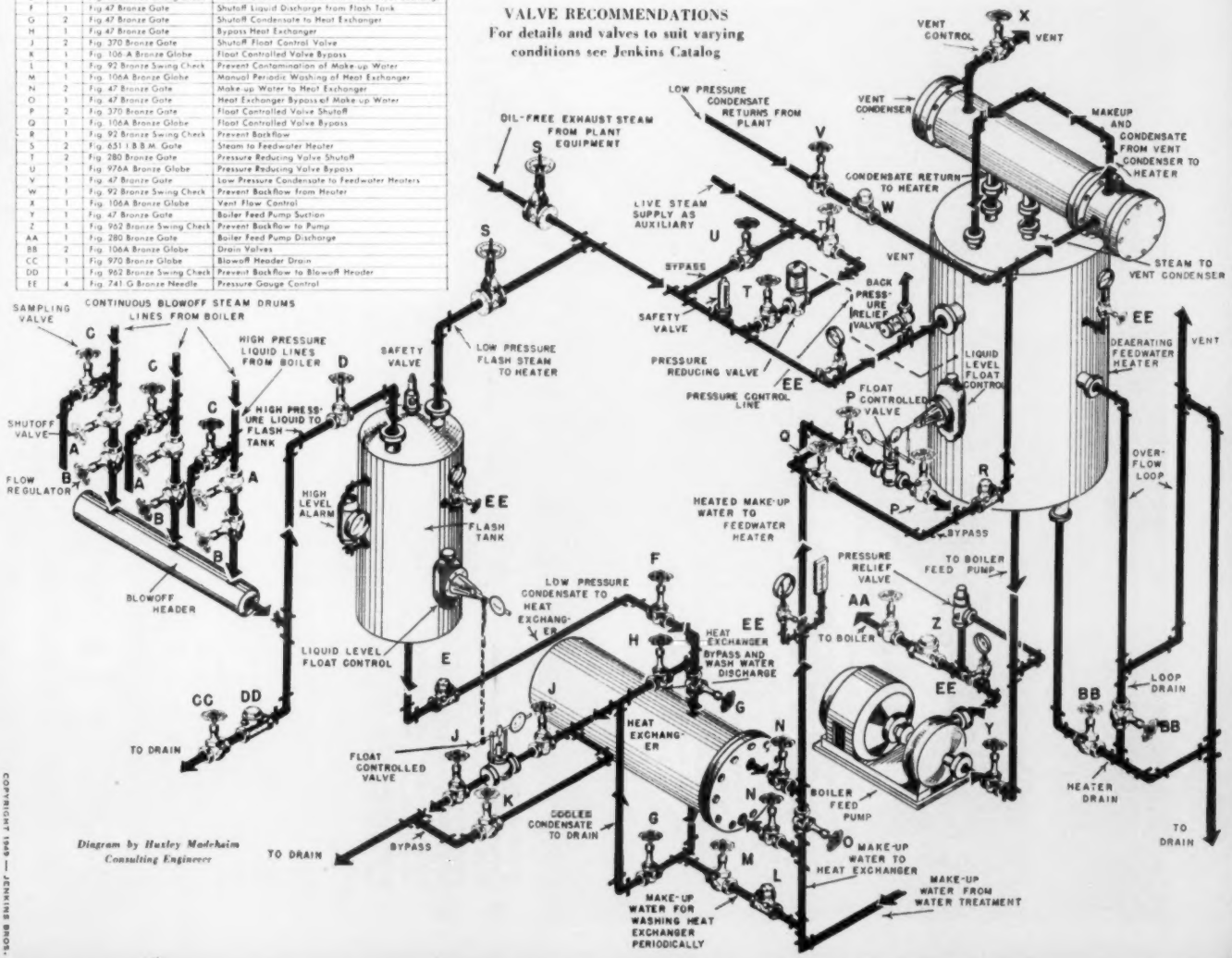

Diagram by Huxley Madeheim Consulting Engineer

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SOLD THROUGH RELIABLE INDUSTRIAL DISTRIBUTORS EVERYWHERE

Heating-System Fuel Consumption

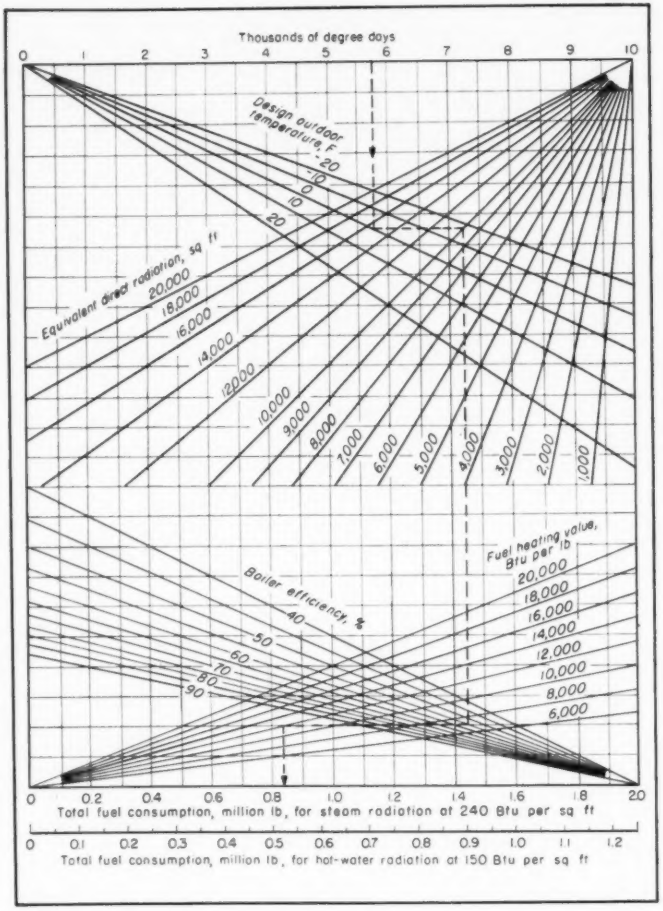
► THIS CHART helps to estimate the fuel consumption of a steam or hot-water system designed according to standard procedures and specific outdoor temperatures. Experience shows that about 96 Btu per degree-day is needed by a steam system designed to maintain 70 F at an outdoor temperature of 0-F when emitting 240 Btu per hr per sq ft of equivalent direct radiation (edr). A hot-water system will use 60 Btu per degree-day for the same temperatures when emitting 150 Btu per hr per sq ft of edr. These factors, as well as corrections for outdoor temperatures, boiler efficiency and fuel heating value, are included. Also assumed in these figures is a 10% heat loss through the piping system.

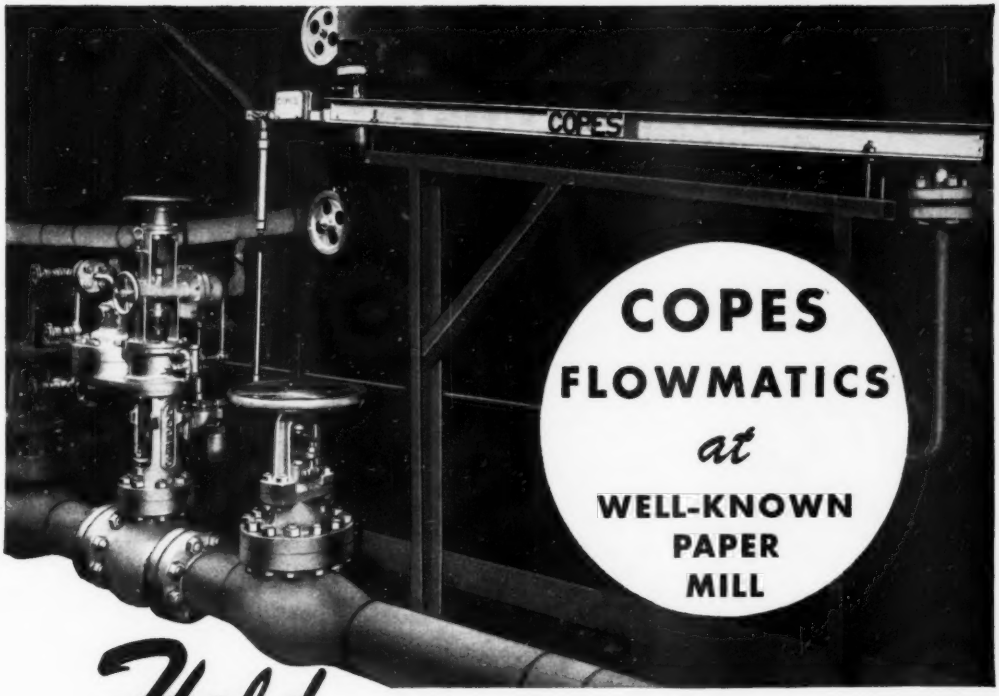
Example: Find the fuel required by a steam system designed for 0-F outdoor temperature for a heating period totaling 5750 degree-days. The steam system contains 10,000-sq-ft equivalent direct radiation, has a boiler operating at an average efficiency of 55%, and burns coal with 12,000-Btu-per-lb heating value.

Follow the trace from the upper scale at 5750 degree-days vertically to intersect the 0-F outdoor temperature curve, then horizontally to the 10,000-sq-ft line. Drop to the 55% boiler efficiency line, move horizontally to the 12,000-Btu fuel-value locus, and then drop vertically to find the answer of 836,000 lb of coal.

If this had been a 10,000-sq-ft hot-water system the answer would be found on the lowest scale, which would then be 523,000 lb of coal.

TYLER G HICKS *New York, N. Y.*





Hold CLOSE WATER LEVEL on fast-steaming boilers taking rapid swings

Here is one of two COPES Flowmatics serving 810-psi, 825-F C-E Type VU boilers in one of New York State's most modern paper mills. Rated at 110,000 pounds per hour, each boiler is subject to a sharp load change every three minutes. Despite this severe service, drum water level is held within plus-or-minus one inch.

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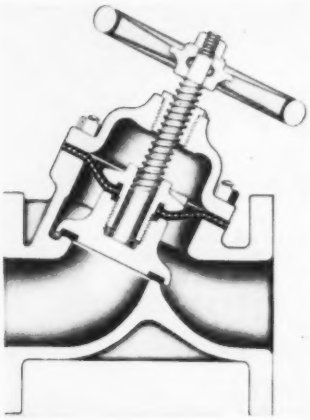
PLANT EQUIPMENT NEWS

Published monthly as a service to readers



Diaphragm Valve E233

A DIAPHRAGM is used to seal the bonnet. A separate seating member, independent of the diaphragm, reduces wear and tear on the diaphragm, says the manufacturer. Two types are available, one plain iron and the other neoprene lined and coated. Both types have bolted bonnets. Iron valves are offered in sizes ½ to 2 in. inclusive, with screwed ends, and in sizes ½ to 4 in. inclusive, with flanged ends. Neoprene lined and coated valves are made with flanged ends only, in sizes ½ to 4 in.

In the unlined valves, a flat-faced disk with neoprene insert assures tight seating under all conditions. The valves have rising stem construction. Sizes 2 in. and under have the stem rising through the handwheel while the larger sizes have the handwheel rigidly attached to the stem and rising with it.

These new valves are recommended for service with compressed air, compressed and liquefied gases, hard-to-hold fluids, corrosive and noxious gases, and other corrosive process fluids. The plain iron valve is designed for services not exceeding 150 psi and 180 F. Temperature limitations on neoprene lined and coated valves depend on service conditions and the fluid carried. A cap to protect stem threads can be supplied for valves of 2 in. and smaller. **Crane Co, 836 S Michigan Ave, Chicago 5, Ill.**

Power Transformer E246

THESE TRANSFORMERS are constructed with many identical standard parts, hence these same parts may be used in transformers of several sizes. Units are available at ratings to 10,000 kva and 34.5 kv for 3-phase application. For single-phase loads, transformers are available rated to 5000 kva and up to 34.5 kv. **Pennsylvania Transformer Co, 808 Ridge Ave, Pittsburgh 12, Pa.**

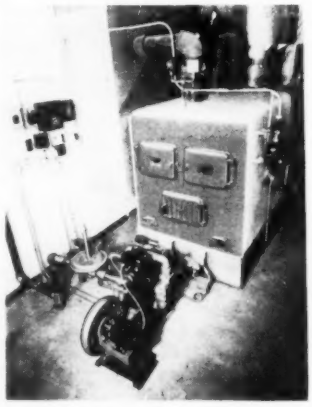
Strip-Type Thermostat E227

SHOCKPROOF, RIGIDLY HOUSED strip-type thermostat is 2½ in. long by ¾ in. wide, and ½ in. high. It has heavy-duty heat-dissipating electrolytic silver contacts with maximum operating temperature of 650 F. Nickel-plated housing can withstand mechanical shock. Rating is 1500 watts, 115- or 230-v ac. **Geo Ulanet Co, 416 Market St, Newark 5, N. J.**

Oil-Inspection Kit E248

A TEST KIT accurately determines condition of lubricating oil. Measurement of the following four classes of contaminants can be made by any workman: amount of asphalt and other gummy material; change of viscosity because of fuel dilution and other causes; amount of dirt, metal particles, other sediment and water; whether acidity has become excessive.

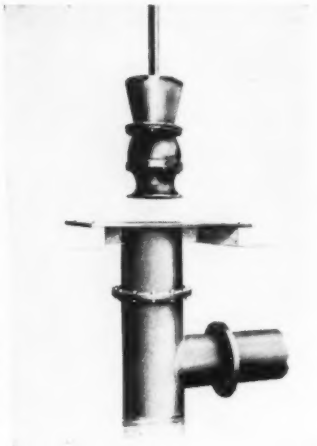
Through simple forms supplied, the trend of contaminants stands out and makes the tests easily interpreted. **Gerin Corp, Red Bank, N. J.**



Gas-Fired Boilers E222

PACKAGED, COMPLETE automatic-burner assemblies for gas burning 350- to 6300-lb-per-hr boilers need only gas piping and electric wiring to go into service.

Principal element is the *Pow-R-Sembly*, which incudes a constant-pressure blower, single- or double-burner nozzle, each with compact proportional mixers, zero regulator, motorized air valve, electric ignition pilot, and manual, reset, safety gas valve. Steam-pressure controls or remote thermostatic control, or both, can be furnished in the package unit. **Bryant Industrial Div, 1020 London Rd, Cleveland 10, Ohio.**



Pull-Out Pumps E250

MIXED-FLOW AND AXIAL-FLOW PUMPS are designed so suction bell, impeller, impeller housing, shaft, motor base and motor can be removed without disturbing column and discharge elbow. They are especially recommended for power-plant condenser circulation water and for other continuous operations where it is desirable to remove all working parts for periodic inspection without breaking pipe or mounting connections. This is advantageous when discharge elbow is below floor or when suction well is not easily drained. Pumps are supplied in either cast or welded construction, and of alloy materials when specified. They are available in sizes up to and including 100,000-gpm capacity. **Economy Pumps, Inc, Hamilton, Ohio.**

Sleeve Puller E234

THREE-JAW PULLER, *CG*-273, uses spring tension to hold jaws on the work and a locking nut to lock puller so it will not come off. Jaws are forged and specially heat treated. Maximum jaw capacity on outside holds is 8½ in. and the jaws are reversible to operate through a 2½-in. opening for inside pulls on bearings, sleeves, etc. Puller is available as either a screw type or combination of screw and booster hammer type. A circular-plate attachment is available to adapt the puller for service on water pumps and generator pulleys,

Use convenient reply cards on page 194a to secure additional information on these new equipment items. Please be sure to identify your request with the new-equipment key letter, *E*, and number, as shown on the items above.

For every fluid . . . or working condition CRANE piping meets the need

For This Boiler Room Piping, for example . . . as for any pressure or temperature condition . . . Crane offers an unequalled selection of valves, fittings, pipe and accessories. One catalog lists the entire line. One order to Crane results in fastest possible service. For Crane serves you through a network of well-stocked cooperating Branches and Wholesalers, also having direct access to large factory stocks.

You can depend on this **Single Source of Supply** to speed and simplify every piping procedure, from design to erection to maintenance of systems. Placing **Complete Responsibility** on Crane for materials helps you to get better installations, avoids needless delays. Relying on the **High Quality** that is Crane Quality assures long and dependable performance from every item in your piping systems.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

ONE SOURCE OF SUPPLY
RESPONSIBILITY
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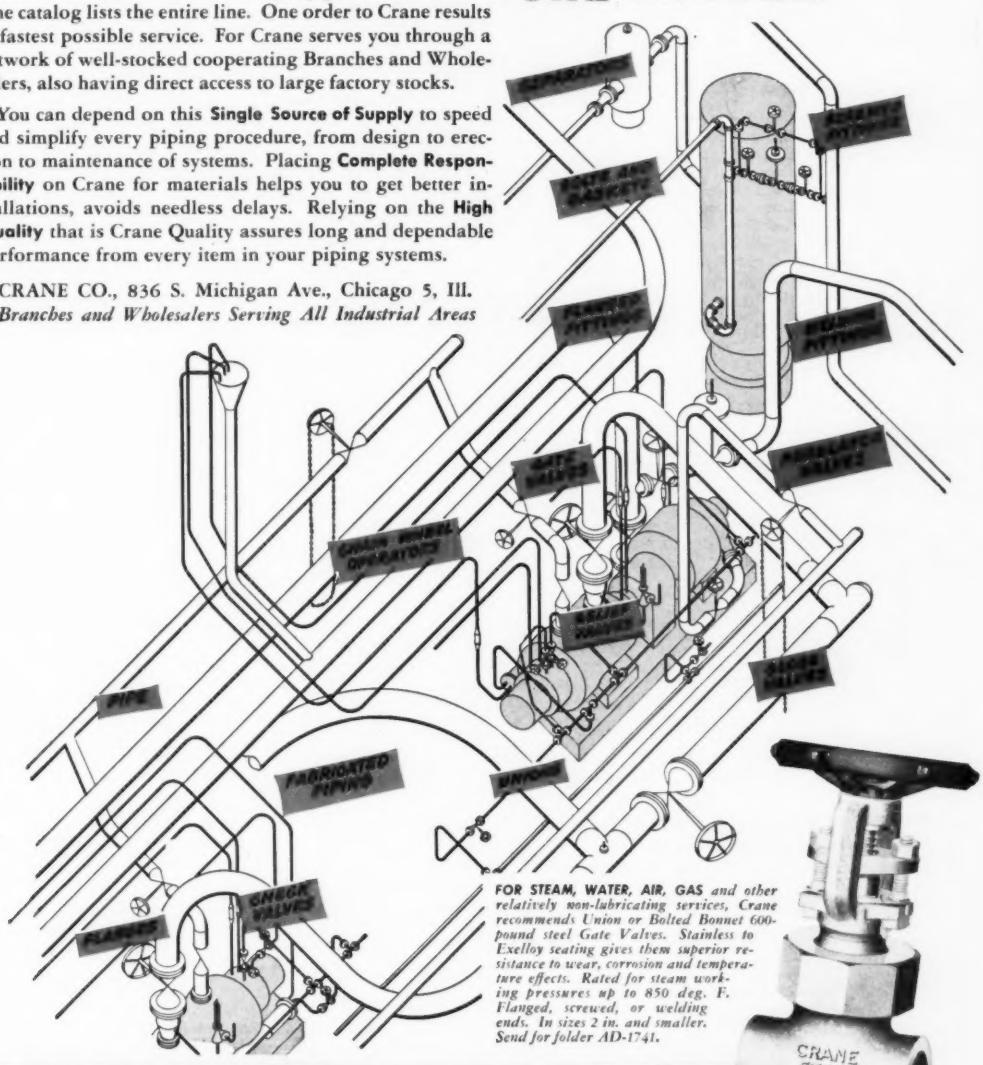
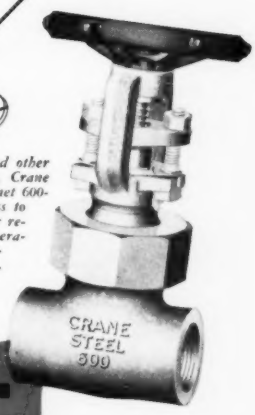


FOR STEAM, WATER, AIR, GAS *and other relatively non-lubricating services, Crane recommends Union or Bolted Bonnet 600-pound steel Gate Valves. Stainless to Exelloy seating gives them superior resistance to wear, corrosion and temperature effects. Rated for steam working pressures up to 850 deg. F. Flanged, screwed, or welding ends. In sizes 2 in. and smaller. Send for folder AD-1741.*



EVERYTHING FROM . . .

VALVES • FITTINGS
PIPE • PLUMBING
AND HEATING

CRANE

FOR EVERY PIPING SYSTEM

tapped fiber gears, and other such units where pulling from the outside might cause damage. The plate attaches to the gear or pulley close to hub by cap screws, and the puller is attached to it in the usual manner. **Snap-on Tools Corp, Kenosha, Wis.**

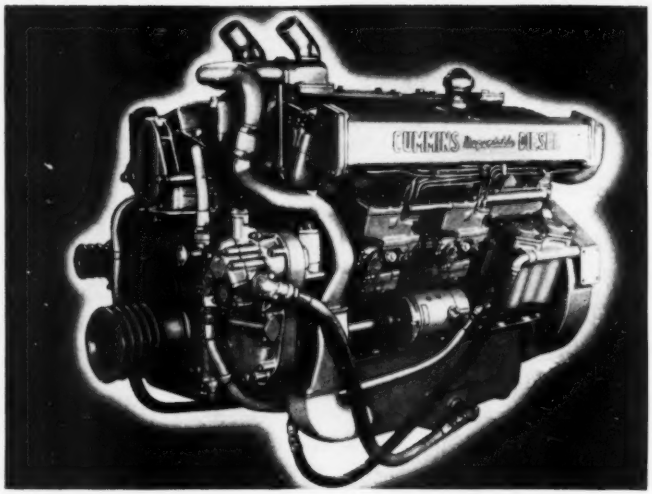
Water-Control Valve E232

ESTO WATER CONTROL protects watercooled equipment against damage through water failure. In operation, the device is adjusted to provide an ample supply of water, but where dirty water is used for cooling compressors or bearings the control can be adjusted so that when flow of water is retarded below the required amount the control sounds an alarm or stops the equipment, or both. Device is available in sizes up to and above 1 in. to operate on 25 to 60 cycles up to 600 v. **Esto Manufacturing Co, Box 771, Allentown, Pa.**

Smoke Indicator E220

PACKAGED SMOKE-INDICATOR UNIT contains light source, phototube holder, and enclosure containing an overfire air control, as well as an indicator calibrated in Ringelmann units.

The phototube holder mounts in duct work or stack. A magnetic relay operates when smoke density reaches a predetermined level. It starts a blower running to force overfire heated air into the firebox until the smoke density decreases. Each time the relay operates it rings a bell to warn the boiler operator to adjust drafts. A chart recorder can be provided to furnish a continuous record of smoke density. **General Electric Co, Schenectady 5, N. Y.**



High-Speed Diesel E252

NVHS-1200 DIESEL is 4-cycle 12-cylinder V-type supercharged unit, rated 550 hp at 2100 rpm. Companion model *NVH*-1200, unsupercharged, develops 400 hp at 2100 rpm. Both have 5½x6-in. cylinders arranged in a 40-deg V with a total piston displacement of 1486 cu in. Over-all dimensions are 73 in. long, 41 in. wide, 57 in. high. With standard accessories, supercharged model weighs 4550 lb (8.3 lb per hp) and unsupercharged model 4300 lb (10.8 lb per hp).

Both units employ the exclusive Cummins fuel system but in a completely redesigned version, which is much lighter and more compact than previous designs. A single pump meters the charge to all cylinders and a distributor directs fuel to the cylinder to be fired. System operates at relatively low pressure up to the injection nozzle, where mechanically actuated plunger produces the high pressure needed for atomization.

Engines have a cast alloy-iron cylinder block, which includes upper half of the crankcase. The forged crankshaft, of alloy steel with Tocco-hardened journals, is underslung from seven main bearings. These bearings and connecting-rod bearings are precision type. Cylinders have removable wet liners. Drop-forged connecting rods have the big end split at an angle for easy removal through the cylinder. Pistons are aluminum; piston pins are full floating. Cylinder heads are cast in groups of three, with stellite inserts on exhaust-valve seats. Dual intake and exhaust valves are heat-resisting alloy steel. Lubrication system is of full pressure type. The supercharged model has a Roots-type positive-displacement blower, gear driven.

Engines are designed for use in off-highway automotive units, mobile mining and construction equipment, shovels, cranes and draglines, industrial locomotives and railcars, logging equipment, oil-well drilling rigs, generator sets and other portable and stationary applications. Auxiliary equipment to suit these applications is available. Marine models are expected to be added to the line at a later date. **Cummins Engine Co, Columbus, Ind.**

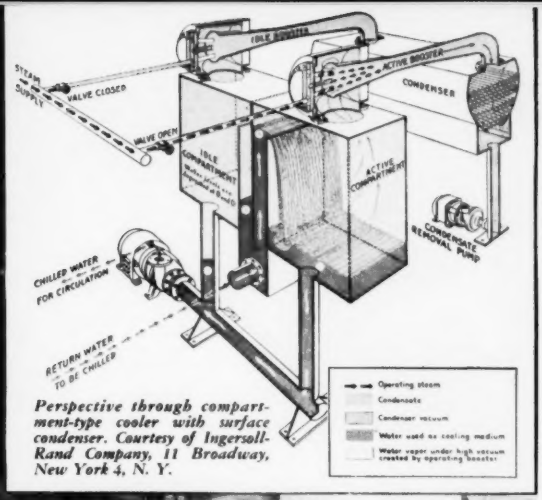
Air Compressor E199

BF-TYPE 2-STAGE AIR COMPRESSORS are built for 200-psi working pressure. Tanks are tested to 300 psi. Standard pressure setting is 160 to 200 psi. Special settings are also available. Displacement ranges from 7.13 to 40 cfm. They are powered by motors ranging from 1½ to 10 hp. Compressors feature *Timken* main bearings, *Lynite* connecting rods, automotive-type pistons, steel valves, totally enclosed copper-finned intercoolers, dustproof crankcase, and a new combination intake-air filter and silencer.

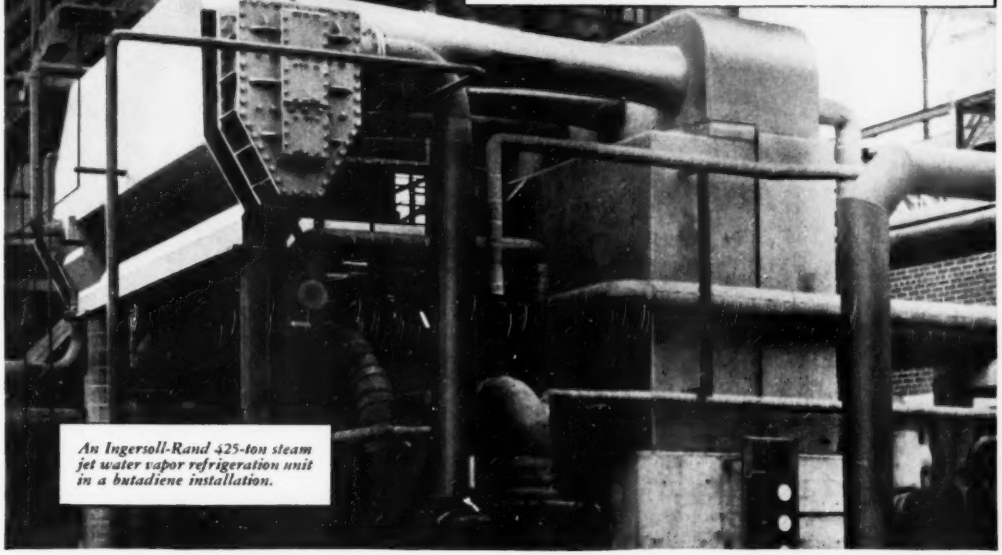
A constant-level lubrication system is used with all models, except the 10-hp unit, which is pressure lubricated. A patented loadless starting mechanism completely unloads the compressor until motor has attained its full load speed on restart. Multiple V-belt drive is supplied for units of 2 hp and up. Standard 1750-rpm motors used on these units are equipped with overload protection starter switches. Each 60- and

Use convenient reply cards on page 194a to secure additional information on these new equipment items. Please be sure to identify your request with the new-equipment key letter, *E*, and number, as shown on the items above.

JET OF LIVE STEAM PROVIDES REFRIGERATION



Perspective through compartment-type cooler with surface condenser. Courtesy of Ingersoll-Rand Company, 11 Broadway, New York 4, N. Y.



An Ingersoll-Rand 425-ton steam jet water vapor refrigeration unit in a butadiene installation.

Large steam jet ejectors, while based on a relatively old principle, are today utilized to produce refrigeration. In its new dress, a jet of live steam at 2 psig or more darting in a properly-designed venturi tube greatly reduces the pressure over warm water. The jet also removes water vapor, thereby maintaining the vacuum and lowering the temperature of the water to that at which it boils, which may be as low as 35° F. Such coolers are in use today in many industries, such as:

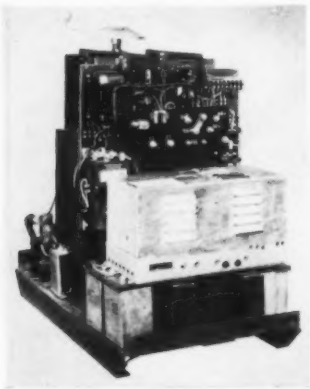
PAPER • MARINE • BREWING • FOOD
RUBBER • CHEMICAL • OIL REFINING
AIR CONDITIONING • GAS PRODUCTION
EXPLOSIVES

Revere is interested in this development for two reasons. First, it is a fine example of the way in which American enterprise uses its intelligence and initiative to obtain new values from old ideas. Second, the coolers use steam and water, and require non-rusting copper alloys of high heat conductivity in such forms as condenser and heat exchanger tubes and plates, which Revere makes.... Revere has a great deal of information about its alloys and their applications to various conditions of use. Why not use that knowledge as well as our metals? The Technical Advisory Service will gladly cooperate with you.

REVERE
COPPER AND BRASS INCORPORATED
Founded by Paul Revere in 1801
230 Park Avenue, New York 17, New York

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.
Sales Offices in Principal Cities. Distributors Everywhere.

80-gal tank comes with 2½-in. diameter, 300-psi pressure gage, safety valve, tank drain and shut-off valve. **Binks Mfg Co, 3114-40 Carroll Ave, Chicago 12, Ill.**



High-Frequency Welder E228

TUBE-TYPE OSCILLATOR and specially designed torch enables high-frequency inert gas arc welding. Unit remains on assigned frequency of 27,120 kilocycles. The Gasarc oscillator is a full-wave, self-rectifying, single electronic tube. It comes in six models ranging from 150 to 750 amp. **National Cylinder Gas Co, 840 No. Michigan Ave, Chicago 11, Ill.**

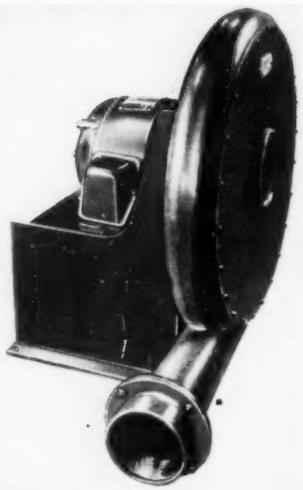
Depth-Hardening Compound E219

CYANIDE-FREE, nontoxic, depth-hardening compound, *Hi-Speed-It*, hardens drills, chisels, gauges, caulkers, reamers, dies, taps, cutting tools to any desired depth in a matter of minutes. Ordinary wire nails, so hardened, can be driven through an automobile spring leaf.

Object to be hardened is: (1) heated to a cherry red color in an ordinary plumber's torch or an open forge or furnace (2) dipped, rolled or stirred in the *Hi-Speed-It* powder (3) allowed 15 to 30 sec for the powder to fuse and form a crust, (4) lightly sprinkled with compound again (5) quickly quenched in clean, cold water or brine. **Wilson Carbon Co, Inc, 60 E 42nd St, New York 17, N. Y.**

Test Switch Covers E241

COVERS ARE FULLY INSULATED, hence they cannot cause a short-circuit when being installed or removed. Front or back models shown are available in four sizes for 4½-, 7½-, 9½-, and 11½-in. switch bases. **Meter Devices Co, Canton, Ohio.**



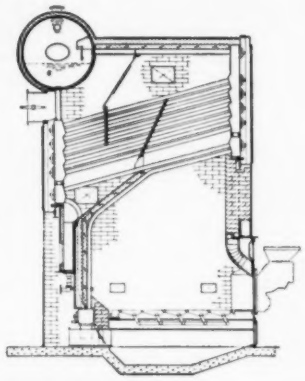
Blowers E226

SINGLE-STAGE, centrifugal blowers have full 360-deg positioning of the air outlet. Units are belt-driven and specially designed to take up only half the floor space required by previous models. **Lindberg Engineering Co, 2444 West Hubbard St, Chicago 12, Ill.**

Industrial Grease E244

THIS GREASE is suitable for heavy-duty applications particularly where bearings are worn. It is not designed for service in electric motors nor in ball or roller bearings where a soda-soap grease is recommended.

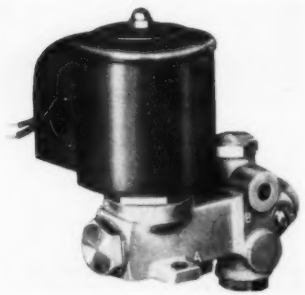
The main feature of this new grease, designated as *STA-PUT 18H-2*, is its high melting point. Although it is a waterproof grease, its melting point is 100 deg higher than that obtainable with a straight aluminum-type grease. **E F Houghton & Co, 303 W Lehigh Ave, Philadelphia 33, Pa.**



Standardized Boilers E229

SIX NEW STANDARDIZED BOILERS in the company's *Type M* line are especially designed for coal firing with standard stokers and can be readily adapted to oil or gas firing. Sizes range from 7500 to 17,000 lb per hr.

Boilers are made with two standard tube lengths, 10 and 12 ft, expanded into sinuous steel sectional headers. Furnace widths vary from 4 ft 7½ in. to 9 ft, depending on whether 5, 6, 7, 8, 9 or 10 header sections are used. All boilers have 48-in. dia welded, X-rayed and stress-relieved drums built to various pressures from 160 to 320 psi. Over-all setting height is 18 ft. **Springfield Boiler Co, 1953 E. Capitol Ave, Springfield, Ill.**



Solenoid Valve E236

PACKLESS 3-WAY SOLENOID VALVE handles steam up to 250 psi, 450 F. Valve is operated directly by solenoid through a power-multiplying internal lever. Solenoid is protected with brazed core-tube joints that insure necessary seal for steam service. Coils are of either high-temperature glass-

Use convenient reply cards on page 194a to secure additional information on these new equipment items. Please be sure to identify your request with the new-equipment key letter, E, and number, as shown on the items above.

STANDARD OIL COMPANY (INDIANA) Power Plant, serving a refinery at Wood River, Illinois. Built during World War II, it is one of a number of large-scale facilities constructed by Dravo to satisfy the varied power needs of many diverse industries.

DRAVO
CORPORATION
DRAVO BUILDING, PITTSBURGH 22, PA.

Engineering Constructors of power plants, boiler plants, central stations, compressor stations, water pumping stations—fabricators and erectors of power piping—power and boiler plant equipment.

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insulated winding or silicon winding, constructed for continuous duty. All valves are supplied standard with cast-bronze bodies, although cast-iron bodies are available at extra cost. Valve seats, disks and springs are stainless steel and operated by a stainless-steel internal lever.

All valves are of extra heavy-duty construction, with some types designed for operating frequencies up to 400 per minute. Pipe sizes are ⅛, ¼, ⅜ and ½ in.; port sizes, 3/16, ¼, 5/16 and ⅜ in. Valves are available standard with NEMA Type 1 solenoid enclosure; and at extra cost, explosion-proof solenoids approved by Underwriters' Class 1 Group D requirements or water-tight solenoid housings to meet NEMA Type 4. **Automatic Switch Co, Orange, N. J.**

Wick Oiler E211

VARIABLE-FEED WICK OILER is suitable for any equipment that has solid bearings where a measured quantity of filtered oil must be fed from the top. Oil feed is controlled by varying size of wick inclosed in tamperproof base fitting.

Metal parts are plated to resist corrosion and simplify cleaning. Oil supply is always visible because of the shatterproof, clear plastic, bottle-like container. Units are available in four types: with or without sight fitting, with or without feed shutoff; 1-, 2-, 4- and 8-oz capacities in each type. **Trico Fuse Mfg Co, 2948 North 5th St, Milwaukee 12, Wis.**

Flexible Power Bus E249

DESIGNED TO PROVIDE both trolley power takeoff and a continuous outlet for fluorescent lights and small tools, this busway provides 2-, 3- and 4-pole construction in one compact housing. Plugs or trolleys are polarized so loads may be balanced on both sides of busway. Because it is built in standard fittings, such as elbows and radius sections, custom-engineered installations may be made economically. **Trumbull Electric Manufacturing Co, Plainville, Conn.**

Air Filters E221

COMPLETELY AUTOMATIC, self-washing air filter consists of banks of 20x20x4-in. filters inclined at 30 deg toward the air flow. Number of units in the banks can be varied to meet any cfm requirement.

A constant-displacement pump, controlled by a timer, delivers oil to the filter banks to re-oil the filters after washing. The washing takes place periodically through water nozzles on the entering side of the filter. The re-oiling follows through a set of oil nozzles. **Farr Co, Los Angeles, Calif.**

Hydraulic Dynamometer E240

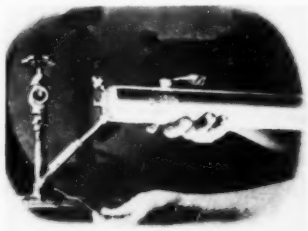
THIS DEVICE is suitable for service in electric-motor repair shops or laboratories where accurate load testing of motors is an important question. Among the tests that can be made with this device are idle, pull-in, pull-out, full-load and locked rotor. The locked-rotor test can be made without having to shut off the motor to insert a locking pin or similar device.

All tests require but little effort on the operator's part since dynamometer is foot controlled and both the operator's hands are free. Exact torque in ftlb may be read directly from gage furnished with dynamometer.

Units are available handling up to 300 ftlb and 2⅞-in. motor shaft. All dynamometers are built to order. **Wagner Electric Corp, 6488 Plymouth Ave, St. Louis 14, Mo.**

Welding Electrodes E230

LARGER-DIAMETER ELECTRODE, *Eutectrode* 24/49, in ¼-in. size answers the need for larger welding electrode for heavy cast-iron castings. New rod has special *FRIGIDARC* coating, works with either ac or dc, produces welds with tensile strength of 50,000 psi and Brinell hardness of 150-200. **Eutectic Welding Alloys Corp, 40 Worth St, New York 13, N. Y.**



Gas Torch E235

TORCHMASTER is a general utility, self-contained hand torch using such liquid petroleum gas fuels as butane, propane, etc. It has a filtered tip that produces a variable sootless flame ideal for light brazing, all types of soldering, and heating applications. A single-control valve varies the flame from a pencil point to blowtorch size. Size is 2¼x13 in. Each torch bears specific stamp of inspection of Interstate Commerce Commission. One filling will last an average working day, and torch can be refilled from standard containers of the fuel. **Industrial Engineered Products Co, 7416 Melrose Ave, Los Angeles 46, Calif.**

Dual-Fuel Boilers E223

EASY CHANGE from gas to oil firing features new line of packaged steam generators, ranging in capacity from 700 to 17,500 lb per hr, at pressures from 15 to 200 psi. All that need be done is swing the horizontal rotary oil burner open and insert the primary gas burner in the normal oil-burning fire port.

Primary burner handles 25 to 30% of

(*Continued on page* 182)

Use convenient reply cards on page 194a to secure additional information on these new equipment items. Please be sure to identify your request with the new-equipment key letter, E, and number, as shown on the items above.

How TIMKEN® bearings help a gearmotor take good care of its teeth

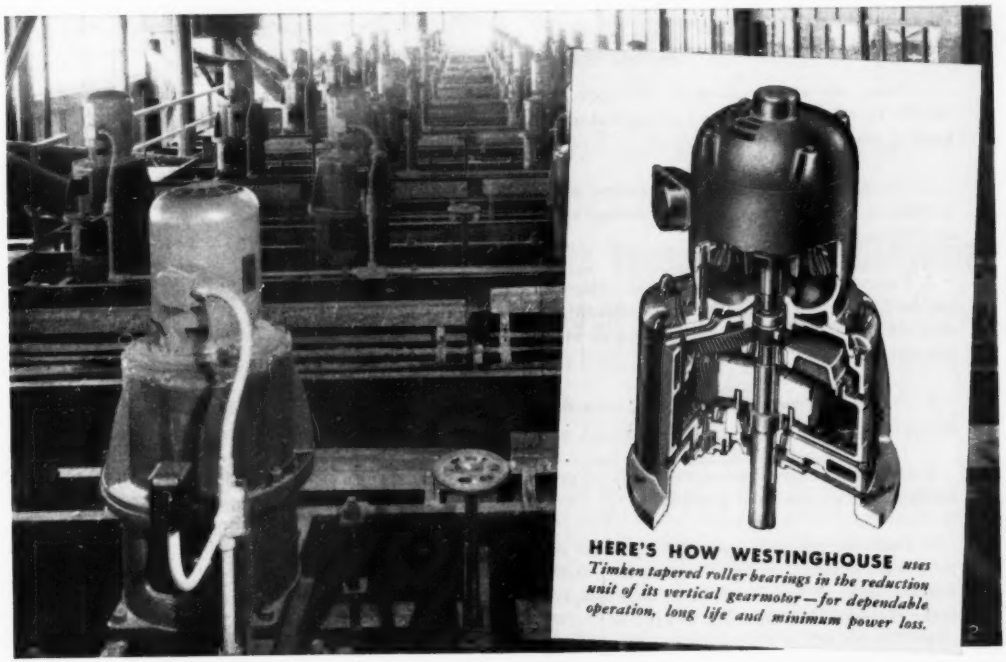
USED to provide on-the-spot power for agitators and mixers, Westinghouse vertical gearmotors have the gear reduction shafts mounted on Timken® bearings to assure smooth gear meshing and long, trouble-free service.

Thrust loads imposed by the vertical operation of the gearmotor are no problem. Due to their tapered construction, Timken bearings carry both radial and thrust loads in any combination. And because Timken bearings operate frictionlessly, power losses are held to an absolute minimum.

With Timken bearings, shafts and gears are kept in rigid alignment. Deflection and end-play are eliminated—gears mesh smoothly at all times. There's less wear on gear teeth. Quiet operation is assured.

Timken bearings are made of the finest steel ever developed for tapered roller bearings—Timken fine alloy steel. They're manufactured to incredible precision, finished to amazing smoothness. No other bearings can give you so many advantages. See that the trade-mark "Timken" is on the bearings of all the machines you build or buy. The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



HERE'S HOW WESTINGHOUSE *uses Timken tapered roller bearings in the reduction unit of its vertical gearmotor—for dependable operation, long life and minimum power loss.*

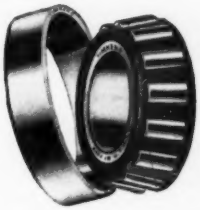
NEW TIMKEN BEARING CUTS RUN-OUT IN HALF!

Until now, the Timken "Zero" bearing has been the last word in bearing accuracy. Now Timken offers industry the "Double-Zero" bearing—*twice as accurate* as the "Zero"! Maximum run-out of the new "Double-Zero" bearing is only 75 millionths of an inch—*half* the 150 millionths run-out of the "Zero" bearing.

What an opportunity for manufacturers of machines where extreme accuracy is essential! Available in standard single row types, up to 10" O.D. Write for further information.

TIMKEN

TAPERED ROLLER BEARINGS



NOT JUST A BALL ○ NOT JUST A ROLLER ⊂ THE TIMKEN TAPERED ROLLER ⊂ BEARING TAKES RADIAL ⊂ AND THRUST ⊂ LOADS OR ANY COMBINATION

Let's Not Have Another One

Depression, I mean. The boys are beginning to pass around the rumors about layoffs, production stops, curtailments, etc. A sidekick of mine tells me he can't get the money he needs for new equipment because management has adopted a policy of "watchful waiting." Well, the true facts of the current situation are these:

1. There are some individual soft spots, but NOTHING on which to base a forecast that we are heading into a serious recession.

2. The consuming public is *not* running out of purchasing power; in fact, stored-up savings are at an all-time high.

3. Expenditures for new plants and equipment are *not* bogging down. Commerce Department figures show no more than seasonal slowing-up in the first quarter of 1949.

4. Volume of home building is being maintained at satisfactory level.

5. Government expenditures, now 25% of gross national product, are holding steady.

6. Declining prices abroad, affecting dollar supply, are not hindering exports. Imports have shrunk 300-400 million dollars, but that isn't large compared to the Marshall Plan 12 billion in exports.

7. Since February, unemployment has slowed down, and at present writing is at about the minimum considered healthy for full-employment times.

To sum up, instead of heading into a recession, business is getting back to normal competitive conditions. This means that companies aren't laying in heavy stocks of inventories, but are living off their fat in expectation of price drops. And the 2-year backlogs of many companies have disappeared, but these were to a large extent paper orders anyway.

As one of my associates said recently, "In my time, we have talked ourselves into two depressions, and if we try real hard, I guess we can do it again." There's no real reason for the jittery thinking some of us have been hearing, and let's not add fuel to the flame by reciting the woes of some company which has getten into trouble because it was sloppily run, its power plant was lousy, or its salesmen were asleep.

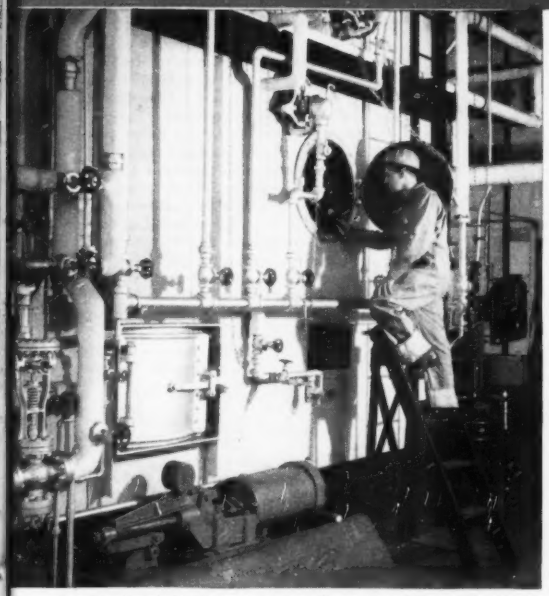
Instead, let's do some constructive thinking on ways of cutting costs and getting rid of obsolescent equipment in our plants. And if the boss claims he has to wait to see what's going to happen, make him sit down with you and go over the figures. Can he afford to twiddle his thumbs when he can put in new insulation that will pay for itself in nine months? Can he afford to overlook savings resulting from a new boiler that will permit him to knock 2% off the price of his product? Not if you can prove to him that your figures are right.

Yes, the honeymoon is over, but it looks like a pretty satisfactory marriage ahead . . . if we will use our initiative and ingenuity in promoting better methods and equipment, leading to reduced power costs.

George Edwards
Engineer

DOWELL

SPECIALISTS IN SCALE AND SLUDGE REMOVAL WITH CHEMICALS



Dowell engineer checking boiler temperature with a pyrometer during chemical cleaning.

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THE DOWELL *service* method of removing scale and sludge from heat exchange equipment has become a regular part of the maintenance program in many industrial plants. Operators have found that giving their cleaning problems to *experienced* Dowell engineers has resulted in the fast, convenient restoration of efficiency and lost power.

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Dowell Chemical Scale Removal Service has a place in your plant. Skilled engineers, specially designed pumping and control equipment, tested solvents and proved processes have stepped up cleanliness standards to new highs. Here is a modern answer to power and maintenance engineers' demands for rapid, convenient, economical cleaning. Ask the office nearest you for a free cost estimate.

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ENGINEER'S BOOKSHELF

REVIEWED IN THIS ISSUE

BASIC REFRIGERATION AND AIR CONDITIONING • COMBUSTION ENGINES HEATING AND VENTILATING BUYERS' DIRECTORY • DESIGN FOR WELDING PAPERS OF 41ST ANNUAL MEETING OF SMOKE PREVENTION ASSN INDUSTRIAL ELECTRONICS AND CONTROL • HOW TO KEEP INVENTION RECORDS TENTATIVE STANDARDS ON PIPE FRICTION • STEAM POWER PLANTS (GERMAN) ELEMENTS OF MECHANICAL VIBRATION • ENGINEERING THE NEW AGE PATENT LAW FOR EXECUTIVE AND ENGINEER • PATENT LAW

Refrigeration, Air Conditioning

BASIC REFRIGERATION AND AIR CONDITIONING, *by R H Emerick, consulting mechanical engineer.* 260 *pp,* 9x5¾, *cloth bound,* 80 *illustrations,* 33 *tables.* $5. *Prentice-Hall Inc,* 70 *Fifth Ave, New York, N. Y.*

Text for this book was originally developed for wartime training of pipefitters, machinists, planners and estimators, called upon to install and maintain refrigeration and air-cooling equipment at Pearl Harbor, Navy Yard.

Approach to the basic theories and much of the equipment is founded on the requirement that the underlying principles be made understandable to everyone, regardless of background.

The original form has been revised and rearranged for students in the trades mentioned above. But the merit of simple, straightforward explanations has been preserved. This is a book that should prove helpful to all students of the subject—both those who are learning trades and those who are developing engineering backgrounds.

Welding

DESIGN FOR WELDING (1948). *Robert S Green, editor, acting chairman, department of welding engineering, The Ohio State University,* 1024 *pp,* 5½x7½, *illust, tables.* $2 *in U.S.A.,* $2.50 *elsewhere. The James F Lincoln Arc Welding Foundation, Cleveland* 1, *Ohio.*

The book contains abstracts of 82 award papers in the recent Foundation "Design for Progress" Award Program. These make available data on welded designs, produced and in operation, which may be adaptable to other products or structures. Inclusion of cost data on various designs makes it possible to study the merits of different methods. Papers are classified as follows: aircraft, automotive, railroad, watercraft, containers, furniture, structures, machinery and welderies.

Smoke Prevention

COLLECTED PAPERS OF THE FORTY-FIRST ANNUAL MEETING OF THE SMOKE PREVENTION ASSOCIATION OF AMERICA. 190 *pp,* 8½x11, *paper covered.* $2. *John Paul Taylor, publisher,* 520 *Pleasant St, St. Joseph, Mich.*

The papers—15 in all—presented before the latest meeting of the Smoke Prevention Association of America make up the contents. They range from a discussion of *What Industry Is Doing About Pittsburgh's Smoke,* by S C Read, manager of maintenance, Jones-Laughlin Steel Co, to practical suggestions on (1) *Stack Smoke and Dust as a Community Problem,* by P W Swain, editor of POWER and (2) *Operating Pointers on Keeping Fuel-Burning Equipment Smoke Free,* by J C McCabe, associate editor of POWER.

Membership of the Smoke Prevention Assn comes mainly from smoke inspectors for the municipalities throughout the U.S.A. and Canada. Their interests, reflected in the collected papers, embrace weather, marine practice, railroad service, stationary power plants, and smoke and dust-collecting equipment.

Pipe Friction

TENTATIVE STANDARDS ON PIPE FRICTION, 82 *pp,* 8½x11, 38 *tables,* 33 *charts and diagrams, paper.* $1.50. *Hydraulic Institute,* 90 *West St, New York* 6, *N.Y.*

Latest data have been used to prepare tables and charts that are arranged in a convenient and usable form.

Friction loss for water is shown in tabular form for pipe sizes from ¼ to 84 in. On smaller pipe sizes, tables are based on wrought iron or steel schedule-40 pipe, and for larger sizes, separate tables are given for each standard size for steel- and asphalt-dipped cast-iron pipe. In each table, flow in gpm and in cfs are shown with the corresponding velocity, velocity head, and friction loss per 100 ft of pipe. Data are carried to three signification figures and are listed in small increments to avoid the necessity for interpolation.

For computing the friction loss for liquids other than water, a series of charts is provided for pipes ranging from ½ to 12 in., showing the complete range of viscous and turbulent flow.

In addition to the friction tables, there is a very complete listing of the losses in valves and fittings. Sectional diagrams of these items are shown to indicate their internal construction. Since there is a lack of uniformity, a range of loss coefficient is given. Data for bends, increasers and diffusers are shown in chart form so as to include the full range of the variable dimensions. These data were assembled from a number of sources and represent the latest and most complete compilation.

The book contains a brief review of the basis of the tables and a complete description of their use. Several illustrative examples are worked out in detail for simple and complex piping arangements. To supplement the use of the friction tables and charts, the pamphlet contains tables on the viscosity and specific gravity of a wide range of commercial liquids and gases, as well as complete tables of dimensions of standard steel, wrought-iron and cast-iron pipes. This information, together with supplementary data on the properties of fluids and charts showing the full range of the friction factor, permits computation of the loss for any liquid or gas in any of the commercial forms of circular pipe.

A complete bibliography gives the source of material used in the preparation of *Tentative Standards.*

Combustion Engines

COMBUSTION ENGINES (1948). *By Arthur P Fraas, Aeronautical Institute of Technology of Brazil,* 439 *pp;* 6x9 *in;* 245 *illust.* $5.50. *McGraw-Hill Book Co,* 330 *West* 42*nd St., New York* 18, *N.Y.*

This book concerns itself with all engines in which combustion products form the working fluid, and thus includes gas turbines. Emphasis, however, is on reciprocating engines of the automotive type, which have the greatest commercial importance. Throughout particular attention is paid to fundamentals, and the relation between theoretical considerations and practical problems of design and operation is clearly brought out. Little time is spent on descriptive matter that "dates" quickly.

For a full understanding of the text, an acquaintance with elementary chemistry, physics and thermodynamics is essential. To the engineer so equipped, this book will prove rewarding for its complete treatment of internal-combustion-engine fundamentals. The material is thoroughly up-to-date, data from wartime and postwar research being included.

Industrial Electronics

INDUSTRIAL ELECTRONICS AND CONTROL (1949). *By Professor Royce Kloffler, head, department of electrical engineering, Kansas State College.* 478 *pp,* 6x9 *in, illust. cloth.* $5.50. *John Wiley & Sons,* 440 4*th Ave, New York* 16, *N.Y.*

Written to give the college engineering student a survey of the theory and applications of electronics in industry, this book

(*Continued on page* 168)

Chapman List 960

...the forged steel gate valve that's

Built to Take it

Chapman was thinking of *your needs* when it designed this sturdy gate valve. That's why there are so many features that mean lower maintenance costs... longer years of useful life.

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But that's only part of it. This valve is designed so you can repack it under full pressure... so that yoke threads are protected against rust and corrosion. And designed without gaskets to blow.

It's available in sizes from ¼" to 2"... carbon steel for pressures to 800 pounds; alloy steel for pressures to 1000 pounds at 750° F. For higher pressures, specify List 990.

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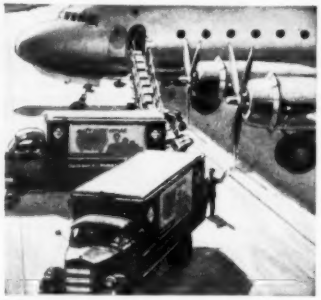

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Mercury-Arc Rectifiers

(*Continued from page* 124)

start again until the start button is closed. When the timer opens contacts P, it closes contacts Q to sound an alarm that indicates failure of the pilot arc to start and calls an attendant.

Ignitron Designs. Another design of single-tank rectifier, known as the ignitron, is shown in cross section in Fig. 5. In this design each rectifier tank is ignited every other ac wave and is extinguished at the end of the rectifying period. This is done by an "ignitor," that consists of a high resistance rod, insulated from the tank but dips into the mercury pool. The ignitor operates on the principle that when current passes between a high resistance, the ignitor, and a low resistance, the mercury, sufficient voltage exists at the junction of the two materials to create a cathode spot that emits electrons. The ignitor may be thought of as performing the same function as a spark plug in a gasoline engine.

In Fig. 5 the graphite grid or shield around the anode serves a different purpose than the grid, Fig. 4. In the excitron the grid is used to control rectifier output where in the ignitron, Fig. 5, the anode shield creates suitable arc conditions. During part of the cycle, the shield is positive to help start anode conduction, while at other times it is negative to shield the anode from ionization that persists in the arc path during the inverse wave.

Firing Methods. There are several ways of firing the ignitron, but the use of a thyratron, connected as in Fig. 6, will serve to demonstrate the principle. Assume a transformer polarity as indicated by the arrows. This makes the anode and grid of thyratron T positive and its cathode negative. As potential increases across T, it will conduct because its grid is positive. This circuit is from the mid-point A of the transformer, through the load, mercury pool to the ignitor of rectifier C, thyratron T, through resistor R to the transformer's right-hand terminal.

Current passing from the mercury pool to the ignitor causes it to spark, creating a cathode hot spot from which free electrons emit. Current then flows from the mercury-pool cathode to the graphite anode. When current starts to flow from cathode to anode, voltage drop across rectifier C becomes so low as practically to short-circuit thyratron T and the ignitor, and they cease to conduct. On the other half of the ac cycle, thyratron T_1 and rectifier C_1 come into operation in the same way as explained for T and C.

Voltage Control. Output voltage of the ignitron may be controlled by de-

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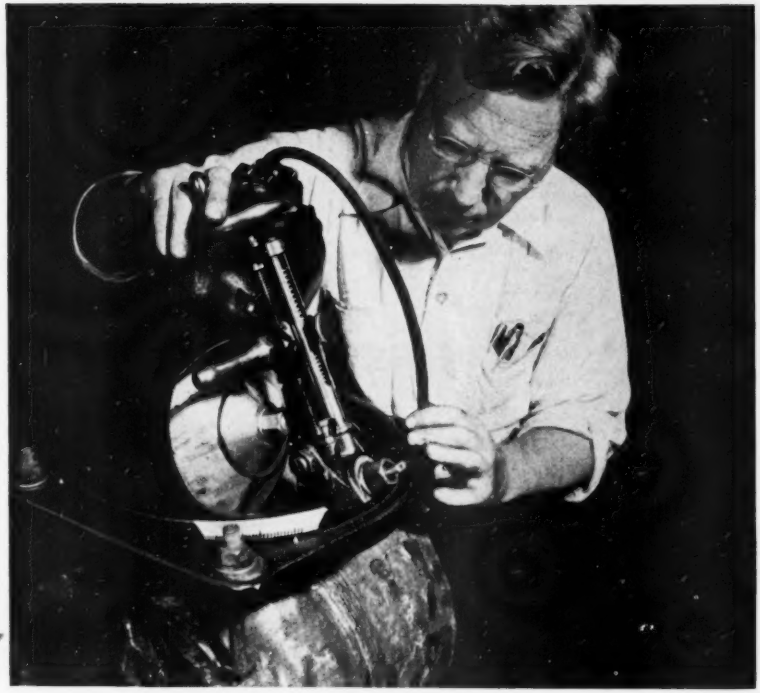
On-Time Delivery made possible by a flexible planning group authorized to re-route work to meet promised dates.



Gouging that pays off!

GOUGING has an unpleasant connotation in most lines of business. But when it comes to power piping, "gouging" means longer life and better service from pipe because it shows you what you can't see by just peering at a pipe installation or scrutinizing a manufacturer's stamp.

Let's take a peek at this thing you can't see. It all starts out with the familiar weld-prober shown above. This portable piece of equipment gouges out boat-shaped samples from pipe that is actually in service position. The holes it leaves are carefully refilled by welding and service quickly resumed.

It's what happens to these samples that is important; that's one of the major reasons Kellogg power piping is held in such high repute.

For some time these gouged-out samples have been used in an exhaustive study of the eccentricities of graphitization — the metal disease that attacks high temperature and high pressure piping during service life and seriously impairs its original strength.

There are some seventy-five talented technicians actively engaged in metallurgical study at Kellogg's Jersey City Laboratories. One of their principal programs is the study of graphitization. Much data has been gathered . . . much more will be forthcoming. Everything that is already known goes toward providing better power piping.

Such invisible technical advancement is duplicated throughout every phase of power piping work—from the use of exclusive stress analyzing equipment to the testing of welds on the actual installation site. It is the important advantage you can't see when you buy power piping from M. W. Kellogg.

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process equipment

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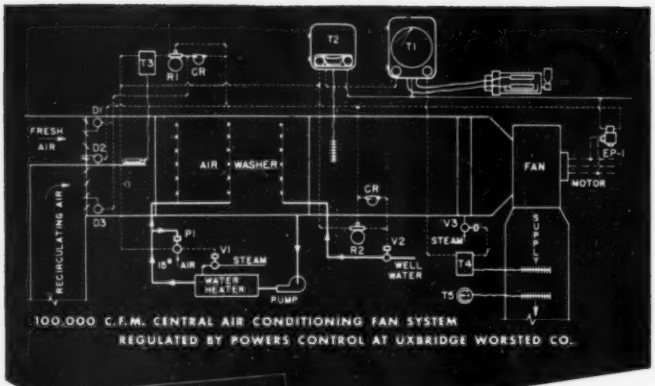

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One	100,000	C.F.M.	fan system
"	80,000	"	"
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(T-2) POWERS INDICATING SUB-MASTER DEWPOINT REGULATORS automatically control the air washers

POWERS dampers, valves, relays and other devices are used with T-1 and T-2 to obtain the accurate control mentioned above.

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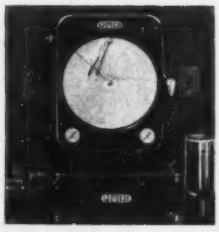
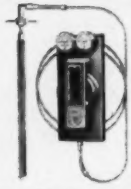
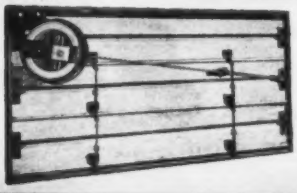
A FEW OF THE MANY DIFFERENT TYPES OF POWERS CONTROLS

Above: T-2 Powers Series 100 Sub-master Dewpoint Indicating Regulator.
At Right: Powers Series 100 Wet and Dry Bulb Recording-Controlling Psychrometer.
Below: D-1-2-3 Powers Louvre Damper.





Above: T-3-4 Powers Type K Remote Bulb Thermostat.
Below: T-5 Powers Remote Bulb Dial Indicating Thermometer.



V-1-2-3 Powers Diaphragm Valve

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laying the starting time of the ignitor. This can be done by a phase-shift device in the thyratrons' grid circuits, as explained in April, pp 125-128. Where this is done the grid circuits of all thyratrons are supplied from a separate transformer instead of from the main anode transformer, Fig. 6. The phase-shifting device can be made adjustable and be controlled by conventional means to obtain any desired rectifier output within its rating.

Mercury-arc rectifiers from 6000-amp rating down to 500 amp are in water-cooled continuously evacuated tanks. That is, vacuum in the tanks is maintained by an automatically controlled vacuum pump. For rating of 400-amp down to 25 these rectifiers can be had in sealed, metal, watercooled tanks.

Sealed Ignitrons. Fig. 7 shows a cross section through a 400-amp sealed ignitron. To eliminate the danger of corrosion the inner cylinder of the tank is made of stainless steel. The anode and its grid are special graphite. Only one ignitor is required but two are provided so if one fails the other can be connected in circuit.

An auxiliary anode provides cathode-spot stability for anode currents below 3 to 5 amp and simplifies ignition-circuit control. The splash baffle prevents small globules of mercury hitting the anode and reduces the possibility of inverse-ignition of the tube.

The 400-amp tube, Fig. 7, is 9 in. in diameter, 22 in. high, with an over-all length including the flexible anode lead of 42 in., and weighs 95 lb. Its control can be by a thyratron as previously explained, or by other suitable means. Auxiliary anode current is supplied by a small transformer separate from the main unit.

Rectifier literature of Allis-Chalmers, General Electric and Westinghouse was consulted freely when writing this article.

Technical Briefs

(*Continued from page* 136)

To overcome this difficulty there has recently been an increase in the use of current-limiting fuses in moderate interrupting-capacity controllers. It is difficult to correlate such fuses and controller so that the fuse clears the circuit on partial faults slightly above the interrupting capacity of the controller. This correlation is much easier when current-limiting fuses are used in combination with high interrupting-capacity controllers. In either case, one or more fuses must be replaced after the interruption of the fault.

When air-core reactors are designed to limit fault currents below the interrupting ability of moderate interrupt-

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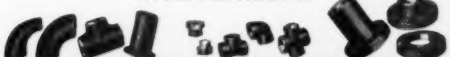

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TUBE-TYPE TOTALLY-ENCLOSED FAN-COOLED

Motors

Maintenance cut sharply on outdoor, corrosive and dirty installations 150 H. P. and up

THE UNIQUE COOLING SYSTEM of the new Allis-Chalmers tube-type, totally-enclosed, fan-cooled motor reduces maintenance to a point never before reached in totally-enclosed motor design. Tubes surround the stator. Internal fans circulate air within the motor to transfer heat to the tubes. An external fan moves outside air through the tubes to remove heat quickly and effectively.

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The new Allis-Chalmers tube-type motor rarely needs cleaning because tubes are straight, the air passages unrestricted, and the cooling air flows at sufficient speed to carry foreign matter out with it. Should unusually dirty air conditions make cleaning desirable, tubes can be swabbed out quickly and easily. This new motor can be installed indoors or out in any atmosphere.

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Three years of successful field operation back up this new motor. For information, on how it can mean lower costs for you, contact your nearest A-C District Office or write for bulletins 51R7149 and 05B7150.

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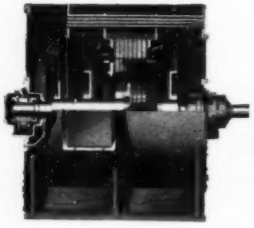

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1. **LARGE HEAT TRANSFER AREA** of tubes plus efficient air flow removes heat quickly.
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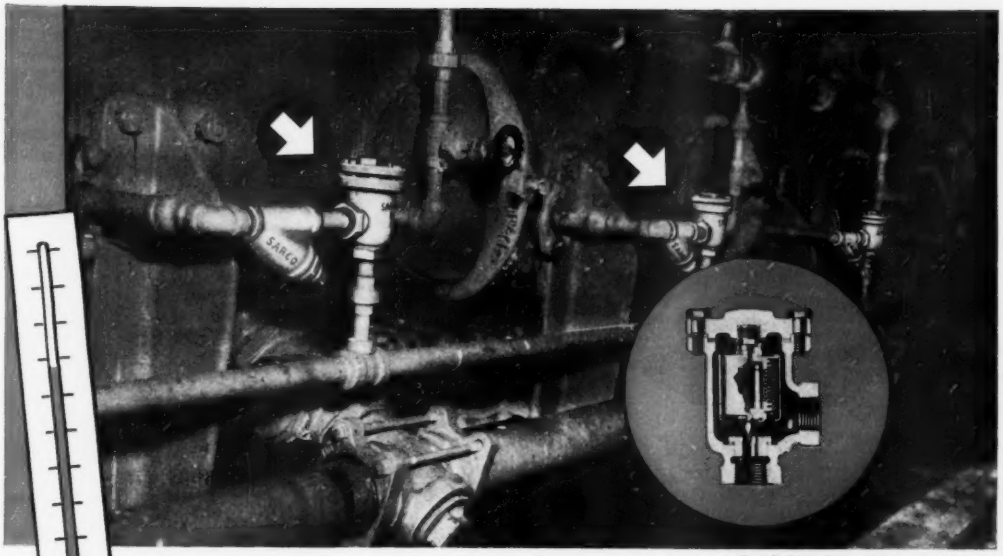

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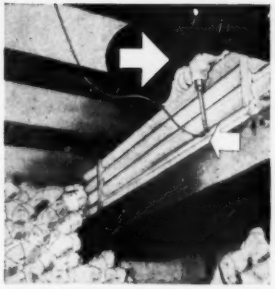

KR-14 Control on ham storage box

TR-21 Temperature Control on can cooler

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ing-capacity controllers, the reactors become too large and costly, and the voltage drop too great. When reactors are designed for use with high interrupting-capacity controllers (50,000 kva), the required inductances are very much less, and this factor, combined with the smaller currents in the motor branch circuit, results in reactors of surprisingly small size and weight.

This paper deals with the design and application of air-core reactors for motor branch circuits in conjunction with high interrupting-capacity controllers. By selecting reactors capable of limiting a source of infinite power to 25,000 kva, much of the time-consuming calculation of system constant is eliminated. There are, however, two factors that limit the range of application of such air-core reactors. One is their increasing size and weight with increase in horsepower, while the other is the reduction in voltage at the motor during starting. These limitations are discussed in detail.

Method of mounting the air-core reactor in the controller enclosure is shown in the figure. The reasons for selecting such an arrangement of the coils are: (1) to reduce the mutual inductance between the coils and assure a reactance per line independent of phase sequence. (2) to provide individual and uniform mounting, and (3) to provide simple and rigid assembly. *AIEE Paper No. 49-117.*

A MANUALLY OPERATED SPRING MECHANISM FOR MEDIUM-VOLTAGE OILLESS CIRCUIT BREAKERS, *by B W Wyman and E J Casey, General Electric Co.* Magnetic oilless circuit breakers, rated 2300 to 15,000 v, require high-contact closing speed to prevent excessive sparking. As these contact speeds cannot be obtained manually, it has never been possible to operate magnetic circuit breakers of this class by manual mechanism frequently used on oil circuit breakers. Where medium-voltage magnetic circuit breakers were applied it was necessary to install a reliable source of closing power. This was a serious application handicap in locations where a reliable source of closing power is difficult and expensive to install.

This paper describes a new mechanism, for operating magnetic oilless circuit breakers rated 2300 to 15,000 v, which has been developed especially for such applications. Energy is manually supplied to this mechanism where it is stored in heavy compression springs until it is released to close the breaker. When this mechanism is released the springs transfer their energy to a rotating mass, which in turn drives the breaker contact. As this rotating mass accelerates until the circuit-breaker contacts meet, its entire energy is avail-

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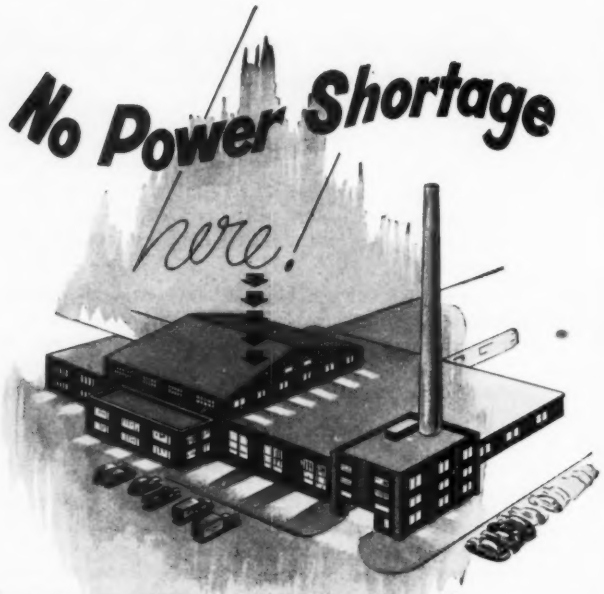

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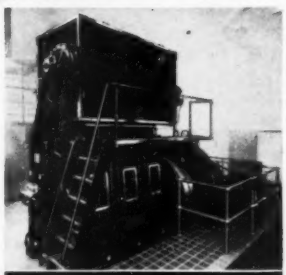

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able for closing and latching the circuit breaker against the magnetic retarding forces of high-current short circuits, if the breaker should be accidentally closed on a faulted circuit. *AIEE Paper No. 49-93.*

WATER TREATMENT

HYDROGEN EMBRITTLEMENT OF HEAT-TRANSFER SURFACES IN POWER BOILERS, *by E P Partridge, C E Kaufman and R E Hall, Hall Laboratories Inc, Pittsburgh, Pa.* During the past decade a new type of embrittlement has been observed. This paper summarizes case histories of ten plants and correlates the accumulated data relating to the effect of the thermal and chemical factors. The intergranular cracking is attributed to the action of hydrogen on the iron carbide constituent in steel. The hydrogen results from the reaction of boiler water with steel, the other product being the black magnetic iron oxide frequently observed in boilers. Action takes place chiefly at 1200 to 1400 psi but has been found at 450 psi. It has also been found in units operating with substantially no dissolved solids as well as those carrying 1500 rpm or more. Severe over heating is not necessary since hydrogen diffusing through the steel acts rapidly on the iron carbide at temperatures as low as 700 F. *ASME Paper, not numbered.*

MEASURING GAS

ERRORS IN HIGH-TEMPERATURE PROBES FOR GASES, *by E Marston Moffatt, Airflo Instrument Co.* The several types of probes are divided into two broad classes: (1) simple bare probes (2) shielded ones. The former are known to be subject to large errors at high temperatures and their readings are frequently corrected theoretically. The shielded types are commonly used without any corrections.

This paper sums up the theoretical background for calculating temperature probe errors and discusses uncertainties in the theory. Then these results are applied to analyzing some typical errors incurred with temperature probes in high-temperature gas-stream regions. The errors are calculated for both the above broad classes of probes. The probable errors for the shielded type in uncorrected readings are included, as well as the large errors theoretically "corrected for" in the bare-type probes. Emphasis is on probable errors inherent in corrected as well as uncorrected temperatures with existing instrumentation. *ASME Paper No. 48-A-52.*

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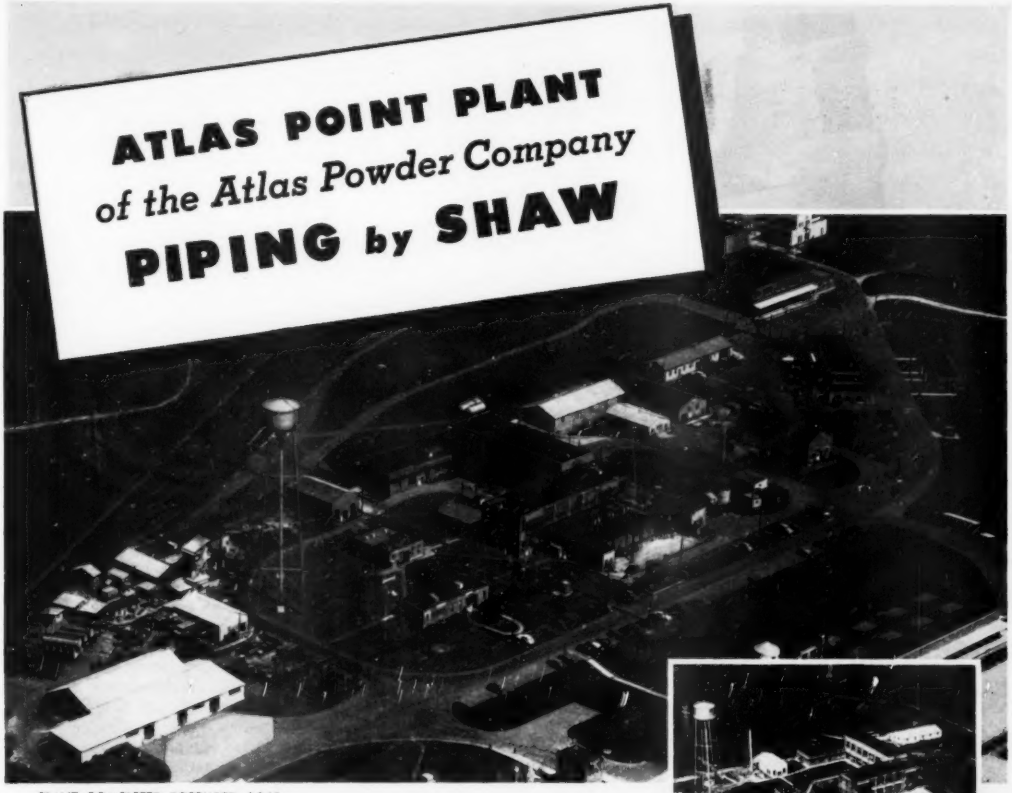
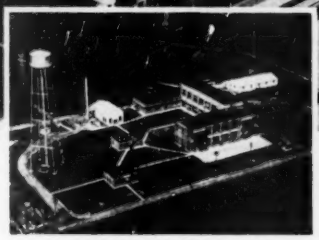


PLANT COMPLETED DECEMBER, 1948



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Hudson Plant

(*Continued from page 75*)

nected to the station now operating at 33 kv will later be raised to 66 kv. Outdoor generator step-up transformer is a 3-phase unit. High-speed oil circuit breakers are controlled from an electrical duplex control board in the station's control center.

Plant Arrangement. The functionally designed building houses boiler, turbine and circulating-water equipment. No division wall is provided between boiler and turbine, allowing greater ease in placing auxiliary equipment. The screenwell, however, occupies a section of the building with a lower roof, and the chlorinating equipment is housed in a section above the discharge circulating-water tunnel. Both are partitioned from the main building. An oil-fired space-heating boiler operating at 15 psig stands in the section with the screenwell.

Actual building volume, including office and laboratory space, totals about 550,000 cu ft. This compares with nominal values averaging 800,000 cu ft for more-conventional designs with the same capacity. Eliminating a loading bay in the turbine room contributes to compactness. Turbine-crane rails extend out through the building wall, supported on steel work so the crane can pick up equipment from trucks or railroad cars outdoors. A special door in the turbine-section wall opens to allow crane and load to move outdoors. Headroom over the turbine has been held to a minimum.

To hold down maintenance costs all building materials, exterior and interior, for walls, doors and ceiling, were selected for their permanent surfaces, eliminating the need of painting.

Because of dust from nearby quarrying operations particular care has been taken to keep the building tight. A forced-ventilation system of four 18,000-cfm fans with air filters keeps the building interior under a slight pressure. Ducts lead the fan discharge to various spots within the building where heat is considerable. From here, air filters through the building and enters the boiler forced-draft fan inlet immediately under the ceiling. During cold weather, preheaters warm the incoming air to 35 F before distribution within the building. During periods of low- or no-load on the station, two 10,000-cfm exhaust fans supplement the boiler f-d fan in ventilating the building.

The compact equipment arrangement keeps the need for operating personnel to the safe minimum. Only four men per shift are needed to run the plant, including one man in the control room where all mechanical and electrical

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Republic Hose is sold exclusively by distributors of industrial supplies. Through years of experience, these distributors have gained the knowledge to recommend hose which will serve your requirements with greatest satisfaction. Write or mail the coupon for the name of the Republic Distributor in your area.

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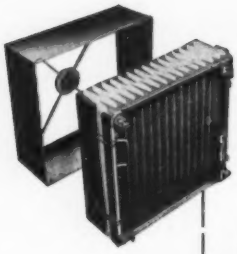
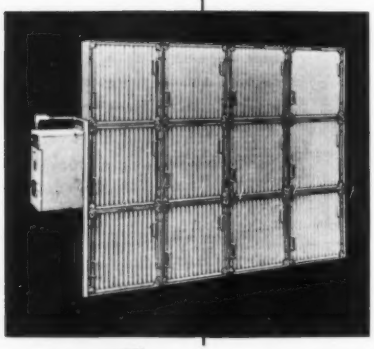


A new filter for air cleaning jobs* that demand something better

New Electro-PL offers intermediate cleaning efficiency at lower first cost

THE new AAF Electro-PL filter is designed for those applications requiring better than normal air cleaning but do not justify the higher cost of super-clean air.

This dry-type electronic air filter averages 60% efficient by the Discoloration Method of Testing without the aid of an ionizing unit. Filtering media consists of Airmat* paper whose inherently high cleaning efficiency is almost doubled under electrostatic charge.



Elimination of ionizing unit assures a lower first cost, reduces power consumption and makes for simplified installation and maintenance. And with the Electro-PL on the job you enjoy positive protection at all times. If the electronic action should become inoperative, the air will continue to be filtered efficiently by the Airmat paper.

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*Airmat is the trade-mark (Reg. U. S. Pat. Off.) of the American Air Filter Company, Inc., for various air filters, dust collectors, and filtering media.

boards are centralized. All auxiliaries are motor driven. All moving equipment, except the coal conveyor, has been kept on the operating floor and below. Automatic combustion control and 3-element feedwater control contribute to the ease of centralization.

Installed cost of Unit No. 1 averages $200 per rated kw. This includes cost of coal-handling system, circulating-water tunnels, screens and intake, fresh-water line and land. With the same prevailing prices and labor rates, next unit will cost about $185 per kw because of the common apparatus that was installed with the first unit.

POWER is indebted to the Rockland Light and Power Co and to Burns and Roe, Inc, for the data and photographs in this article.

Engineer's Bookshelf

(*Continued from page* 154)

is so practical that it will be useful to everyone interested in electron tubes and their use in industrial control and other circuits.

Beginning with Bohr's early theory of the atom, the text proceeds to the basic theory of electron tubes, associated circuits and control component devices. Latter part of the book covers many electronic applications in industrial and commercial fields. They include rectifiers and inverters, high-frequency heating, resistance welding, electro-static precipitation, electronic operation of dc motors, photoelectric control devices, voltage regulators, power control, amplidyne servomechanisms and X-ray applications. The many large, clear illustrations are helpful in understanding the text, which is written in a simple direct style.

PATENT LAW FOR THE EXECUTIVE AND ENGINEER, *second edition*, (1948). *By H A Toulmin, Jr, patent lawyer*, 231 *pp*, 5½x8, *illust*, $2.95. *Research Press, Inc*, 137 *N Perry St, Dayton* 2, *Ohio.*

A readable book explaining the intracacies of patent law in its many ramifications. It discusses such topics as how to get a patent, when to consult a lawyer, patent purchase and license agreements. Also covered are questions of patent ownership as between employer and employe, how to avoid patent infringements, and how to place a value on patents. Those who are puzzled by the difference between a development and an invention, and what inventions are patentable, will find some of the answers in this book.

HOW TO KEEP INVENTION RECORDS, *second edition* (1948). *By H A Toulmin, Jr, patent lawyer*, 78 *pp*, 5½x8, 12 *forms*. $2.50. *Research Press, Inc*, 137 *N Perry St, Dayton* 2, *Ohio.*

First part of the book discusses the general nature of industrial property and monopolies granted for its protection. Second part outlines a practical method of recording vital dates by a series of a dozen forms. A final chapter covers methods of making patent investigations.

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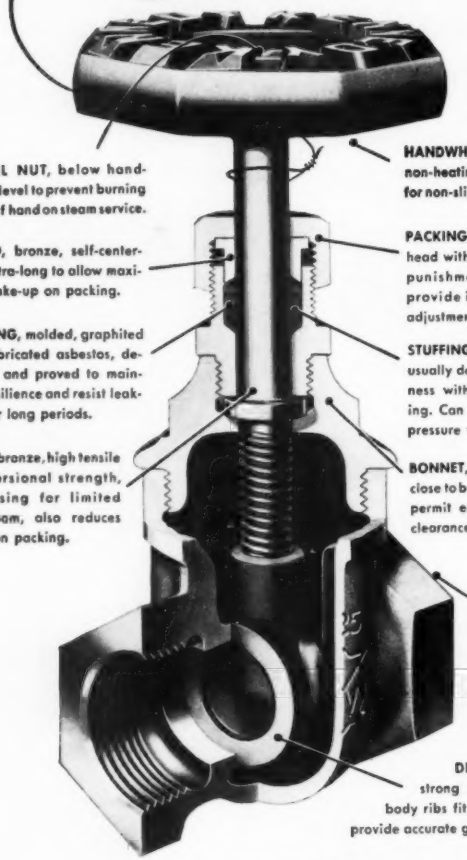
KENNEDY STANDARD BRONZE GATE VALVE, FIG. 27, non-rising stem. Conservatively rated for services up to 125 Steam, 175 Water, Oil or Gas. ¼" through 3" sizes available.



WHEEL NUT, below handwheel level to prevent burning palm of hand on steam service.

GLAND, bronze, self-centering, extra-long to allow maximum take-up on packing.

PACKING, molded, graphited and lubricated asbestos, designed and proved to maintain resilience and resist leakage for long periods.

STEM, bronze, high tensile and torsional strength, non-rising for limited headroom, also reduces wear on packing.

HANDWHEEL, malleable iron, non-heating design, large size for non-slip, comfortable grip.

PACKING NUT, bronze, heavy head withstands pipe wrench punishment, extra threads provide increased packing adjustment.

STUFFING BOX, bronze, unusually deep to provide tightness without jamming packing. Can be repacked under pressure wide open.

BONNET, bronze, large hexes close to body increase rigidity, permit easier removal when clearances are close.

BODY, bronze, rugged construction, straight passageway minimizes flow resistance, disc clears passageway in full open position.

DISC, bronze, simple, strong mechanism. Interior body ribs fit channels on disc to provide accurate guide.

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Long experience has shown that following methods outlined in the book greatly aids in proving claim to priority in the matter of inventions.

PATENT LAW FOR LAWYERS, STUDENTS, CHEMISTS AND ENGINEERS, *second edition* (1949). *By C H Biesterfeld, patent lawyer, 267 pp, 6x9, $4. John Wiley & Sons, Inc, 440 Fourth Ave, New York 16, N. Y.*

Text gives basic principles of the patent law in terms that the general reader should be able to understand. Included are excerpts from the leading decisions of the U.S. Supreme Court and the Federal courts of appeal during the last ten years. Extensive revisions have been made in comparison with the first edition. Since Congress in 1946 abolished recovery of profits, the section of the first edition dealing with "Liability of Infringement" had to be revised, consequently allowing more space for discussion of damages.

ELEMENTS OF MECHANICAL VIBRATION, *second edition* (1949). *By C R Freberg, head, engineering research division, Southern Research Institute, and E N Kemler, research professor of mechanical engineering, New York University, 227 pp, 6x9, illust, tables. $3.75. John Wiley and Sons, Inc, 440 Fourth Ave, New York 16, N. Y.*

The book discusses elementary phases of vibrations, reducing them to the form applicable to practical problems. Many of the problems can be solved by the simpler forms of differential equations, approximate procedures, or by the mobility method. Students and engineers can learn these methods without training in advanced mathematics. They can be used for equipment isolation and determining natural frequencies of a great many different types of systems.

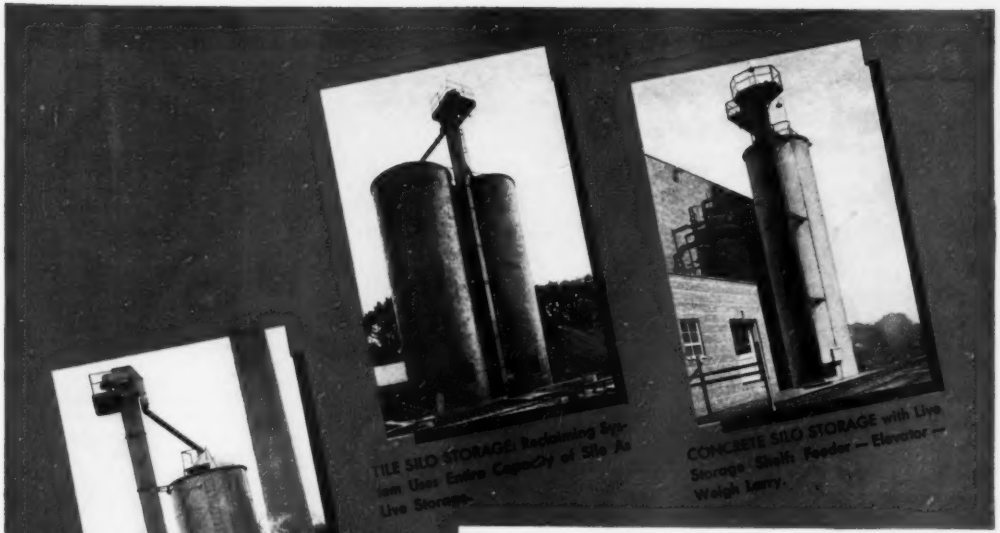
Chapter headings include: Vibrations without damping, Damped vibrations, Vibration of systems with several degrees of freedom, Vibration isolation and absorption, Equivalent systems, Beams, Sound, The mobility method, and Mecahnical and electrical models of vibration systems.

ENGINEERING THE NEW AGE (1949). *By John J O'Neil, science editor, New York Herald Tribune. 320 pp, 5½x8½. $3.50. Ives Washburn, Inc, 29 West 57th St, New York 19, N. Y.*

The author takes the reader through a philosophical discussion of the application of science to everyday living. He points out the areas of failure in the past, especially in regard to functioning of cities. Part of his main theme centers on the recognition of responsibilities to humanity on the part of engineers. He draws some interesting biological analogies about the increasing social consciousness of the engineering profession.

In his optimistic pattern for the future the new knowledge about nucleonics holds the center of the stage. Some of his predictions, based admittedly on speculative information, will undoubtedly draw arguments from practical power engineers. His viewpoint is interesting, however, and broad scope of the book makes stimulating reading.

(*Continued on page* 172)



TILE SILO STORAGE: Reclaiming System Uses Entire Capacity of Silo As Live Storage.

CONCRETE SILO STORAGE with Live Storage Shaft: Feeder — Elevator — Weigh Larry.

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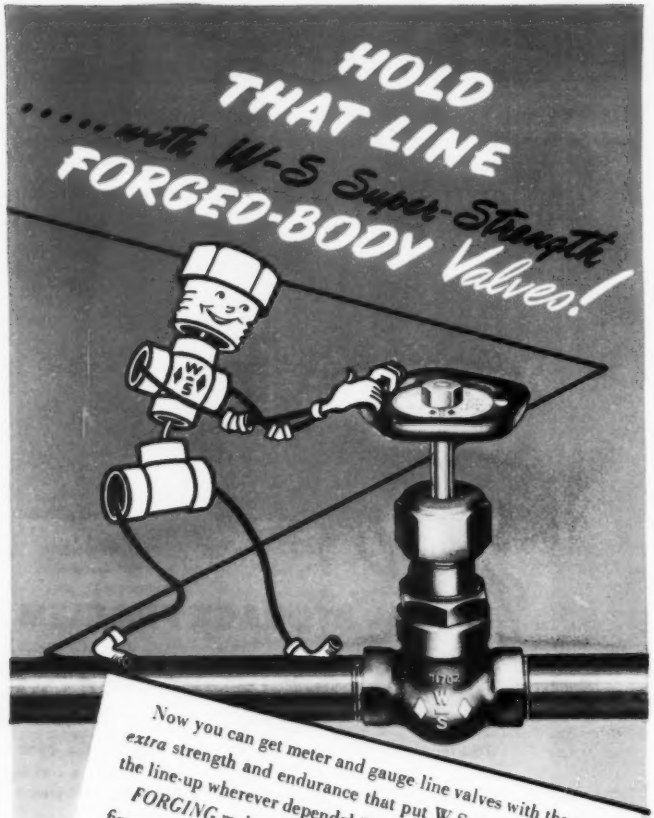

Now you can get meter and gauge line valves with the same *extra* strength and endurance that put W-S *forged* fittings in the line-up wherever dependability is a "must."

FORGING makes the difference . . . compacts the metal, refines the grain into a state of greater uniformity. They are corrosion resistant and have more high-pressure strength than is possible by any other method of manufacture.

PRECISION MACHINED and assembled to exacting W-S standards, *Forged* Meter Valves are offered in ¼, ⅜ and ½ inch sizes for services up to 3000# psi CWP.

Wherever you are, whatever your valve and fittings needs . . . a "Double-Diamond" Distributor is conveniently near to serve you. Write on your company letterhead for the new specifications and list price sheet on Watson-Stillman Forged Meter Valves.

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GERMAN GAS-TURBINE DEVELOPMENTS DURING THE PERIOD 1939-1945 (1949). *By J W Adderly, Power Jets, Ltd. British Intelligence Objectives Subcommittee Overall Report No.* 12, 46 *pp*, 6x9½, 7 *illust, tables*, 35¢, *British Information Services*, 30 *Rockefeller Plaza, New York* 20, *N. Y.*

A brief review of Germany's efforts in developing gas turbines for land and air applications. The efforts and accomplishments of each manufacturer are listed. A 5-page table summarizes the designs.

HEATING AND VENTILATING BUYERS' DIRECTORY, 1949 *edition*. 356 *pp*, 5⅝x8⅛, *paper covered*. $1. *The Industrial Press*, 148 *Lafayette St, New York* 13, *N.Y.*

This latest volume covers the fields of air conditioning, piping, heating, refrigeration, ventilation and air sanitation. It is primarily a product directory, listing the names of manufacturers or sources of equipment, supplies and services. A new section lists local sales representatives and branch offices of manufacturers.

In the trade-name section is information that includes both current and obsolete trade names, together with the product it is associated with, and the name of the manufacturer.

A valuable aid is an index that carries the classified list of products, together with page number of advertisements. The section of the directory devoted to advertisements has eleven major equipment classes, which are separately identified at the top of the classified ad pages.

BOOKLETS

APPLICATION OF ARC WELDING TO LOCOMOTIVES, *by F H Harrison, chief mechanical engineer, South Australia Railways, Adelaide*. 28 *pp*, 8½x5¾, *paper covered. Reprinted from "Design for Welding." Available upon request from James F Lincoln Arc Welding Foundation, Cleveland, Ohio.*

The application of welding as described in this paper shows the development of a program aimed at reducing over-all stoker-weight. A low-grade fuel, readily available, if made suitable for locomotive firing on a 520-class steam locomotive would drop operating costs considerably—so much so that every effort was made to make it practical.

Design requirements indicated that, to develop fuel engine capacity when burning low-grade coal, the furnace grate area and firebox volume had to be much larger than originally furnished. The increase in size meant an increase in weight. So all that had to be done was work out a welding design that achieved a 44% increase in grate area and still stayed within over-all weight requirements.

SPECIFICATIONS AND GENERAL INFORMATION FOR STANDARD INDUSTRIAL SERVICE: 'ELECTRIC OVERHEAD CRANES (*Specification* 49). *Prepared and published by Electric Overhead Crane Institute, 74 Trinity Place, New York, N. Y. Available on application bearing company letterhead.*

Specifications prepared by an organization of the leading overhead crane manufacturers for the purposes of promoting

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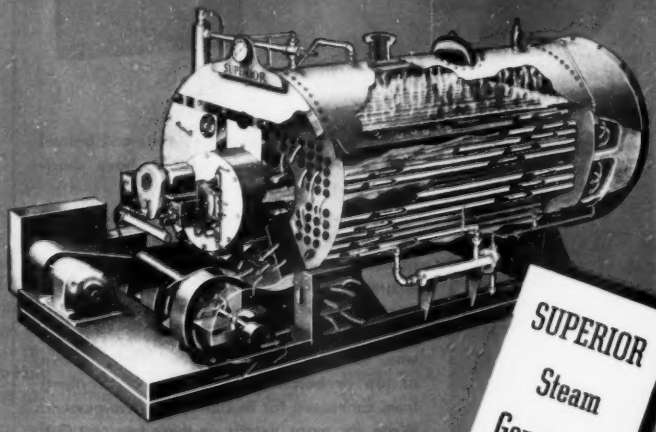

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Steam
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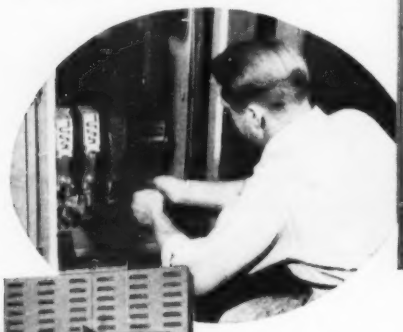
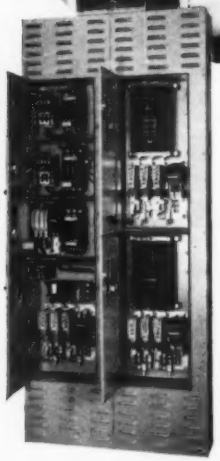
CONTROLLING motors on a process? Economize with standardized, pre-engineered and factory assembled G-E motor control centers. Vertical sections are only 12 inches deep. Standard starter units (NEMA Size 1, 2, 3, and 4 for 1 to 100 hp motors, 440 volts and below) are completely metal enclosed, have short-circuit and overload protection.





Save on wiring costs. Connections to incoming power from vertical bus bars are made in one quick shove by means of "clothespin contact", a special device on the back of each starter unit. Four screws hold unit in place. Wiring troughs are five inches wide, easily reached when cover plates are removed. Terminals are at top or bottom as you prefer. Everything front connected for flexibility of arrangement. Write for more details on these low-cost G-E motor control centers—Bulletin GEA-4979—at the nearest G-E office. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

and providing a basis for uniform quality and performance.

Information, of value to purchasers of cranes and to engineers and architects, has been made available. Specifications are in five parts covering: (1) general specifications (2) trolleys (3) bridges (4) girders (5) electrical.

TECHNICAL PAPER 714; AMINE VOLATILITY AND ALKALINITY IN RELATION TO CORROSION CONTROL IN STEAM HEATING SYSTEMS, *by A A Berk and Nigon, chemists, Boiler Water Research Section, Fuels Utilization Div, Bureau of Mines, 64 pp, 9x5¾, Paper covered, $0.25. Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.*

Corrosion tests were run to compare the usefulness of several amines for treatment of steam systems to prevent return-condensate corrosion. Three amines were used —cyclohexylamine, benzylamine, morpholine—on a test heating system. This system was made up of two 3-drum bent-tube boilers of about 24,000 lb per hr, and 16,000-lbs-per-hr steaming capacity, respectively. They operated at 60 psi and carried a load of about one million lb per day over an area about a third of a mile square.

Makeup was well water put through a *zeocarb* softener equipped with a degasifier. Feedwater consisted mainly of condensate stored in a surge tank above a deaerating feedwater heater.

Boilers were internally treated with metaphosphate and quebracho tannin. Operators strove to maintain a causticity of 30 to 200 ppm OH; a phosphate concentration of 30 to 60 ppm PO_4; and a pronounced tannin color.

Tests were run to determine not only operating characteristics and results, but also estimated savings to be realized.

POSSIBILITIES FOR HEAT PUMP EXPANSION, *by Dr E N Kemler, research professor of mechanical engineering, New York University, 8¼x11¼, 8 pp, paper covered, ten cents. Available through V W Palen, Bureau of Public Information, New York University, New York 53, N. Y.*

Future outlook for the heat pump, with reference to application, heat and energy sources, types of systems, cycles and distribution, forms the subject matter for this booklet. Charts, curves, photos and line drawings compare the operating factors as they apply to residential, commercial and industrial loads.

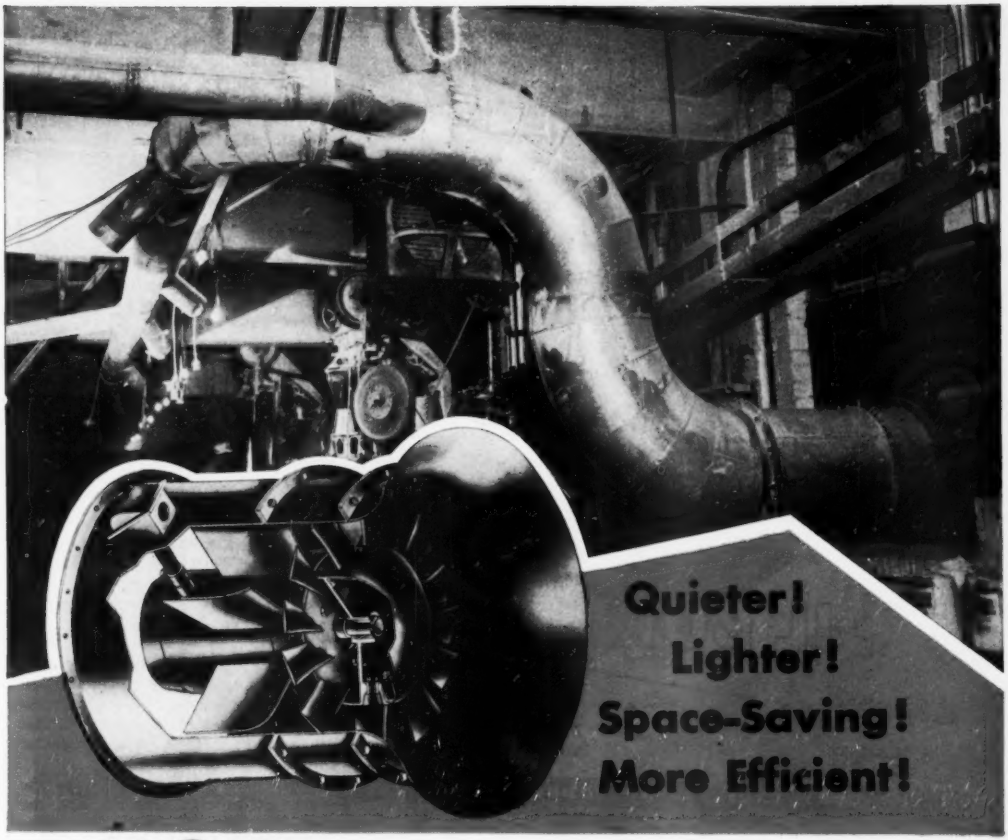
The various earth heat sources have been charted and two operating cycles depicted: (1) the samiple basic vapor cycle (2) a method of staging to reduce power consumption.

Dual-Fuel Engines

(*Continued from page* 113)

engine, the lean limit of good combustion appears to be at about 4.2% gas-air mixture.

Thus the next logical step in development was to govern quantity of scavenging air to more nearly approach a constant fuel-air ratio at all loads. The



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● Let JOY Axivane Fan specialists work with you for best results on your ventilation jobs.

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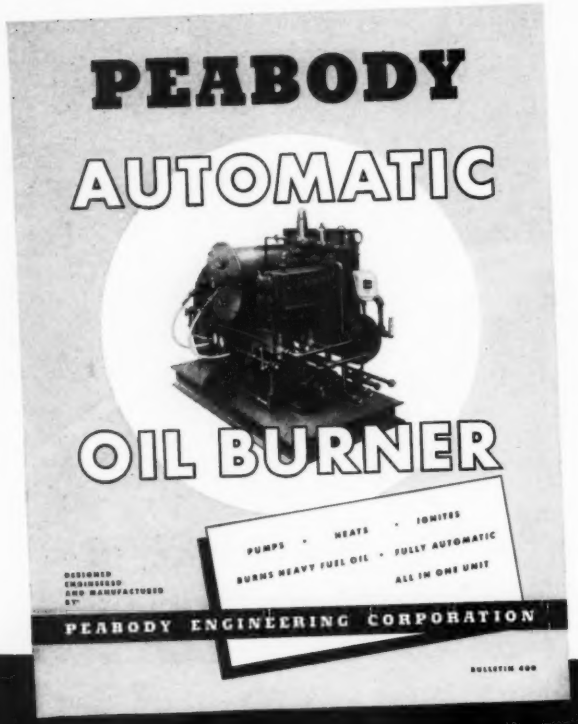

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580 FIFTH AVENUE • NEW YORK 19, N. Y.
Manufacturers of all types of combustion equipment, direct-fired air heaters, gas scrubbers, coolers, and absorbers.

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effect of this change on fuel consumption is shown in Fig. 7. At first it looked as though a relatively small change in fuel-air ratio produced a large gain in combustion but further analysis revealed that a large part of the increase in over-all efficiency resulted from reduced engine friction. This came from lower blower horsepower when scavenging air was reduced. It was thus reasonable to believe that still better economy could be obtained by improving combustion and further detailed improvements in combustion have produced the gains reflected in the lower curve of Fig. 7, representing present performance.

Future Research. Although considerable improvement has been made on 2-cycle dual-fuel gas combustion, it certainly does not appear that the best possible performance has yet been obtained. It is felt, in this connection, that research into ignition properties of various fuel gases (methane, propane, butane, etc), at gas-diesel pressures and temperatures, would be invaluable. Experience at Fairbanks, Morse has certainly shown that butane behaves radically differently from methane insofar as the mixture-ignition-energy curve is concerned and complete data on the behavior of commercially available gases would not only help in engine-development work but would also be of value in predicting performance of present engines operating on various gases or combinations of them.

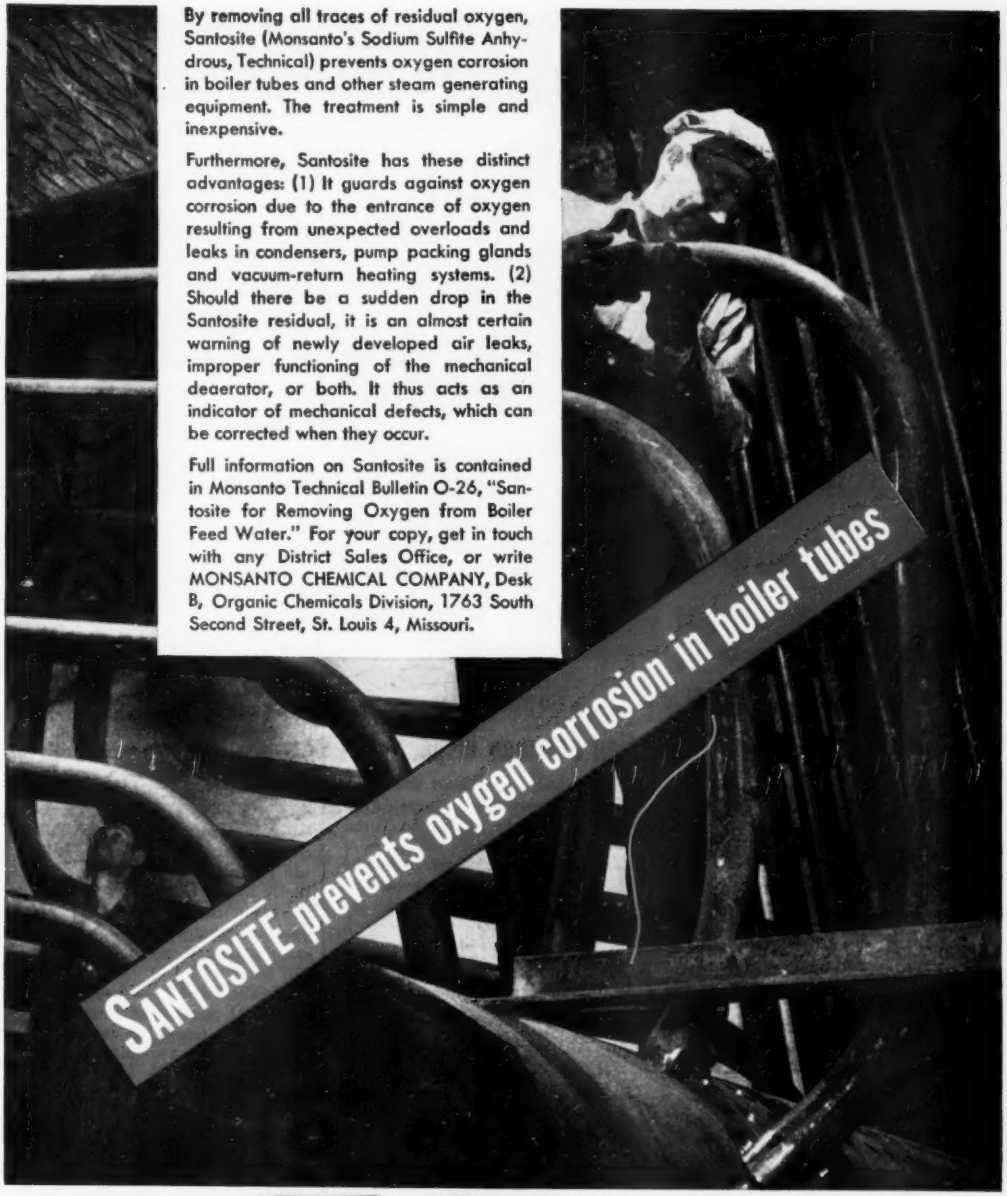
Other Papers. In addition to the paper extensively abstracted here, the following were presented at the meeting: "Dynamic Analysis of Valve Springs" and "Vibrations in Valve Mechanisms," both by Troels Warming, University of Wisconsin; "Effect of Cylinder Pressure Rise on Engine Vibrations," by J O Hinze, Delft Laboratory, Royal Dutch Shell Co; "Diesel Locomotive Engine Cooling System," by F H Brehob, General Electric Co; "Ignition System for Oil Engines," by H B Holthouse, Holthouse Laboratory; "A Training Program for Railroad Personnel," by G Y Taylor, American Locomotive Co; and "Diesel Engine Maintenance Instruction," by S E Lodge, American Locomotive Co.

Plant Problems

(*Continued from page* 132)

offending material. One of the most troublesome turbine-blade deposits is silica which forms a dense, tenacious film on turbine blading with consequent drop in capacity and efficiency.

Second offender is phosphate compounds used for internal boiler-water treatment. Keep in mind, however, that preponderance of any given material



By removing all traces of residual oxygen, Santosite (Monsanto's Sodium Sulfite Anhydrous, Technical) prevents oxygen corrosion in boiler tubes and other steam generating equipment. The treatment is simple and inexpensive.

Furthermore, Santosite has these distinct advantages: (1) It guards against oxygen corrosion due to the entrance of oxygen resulting from unexpected overloads and leaks in condensers, pump packing glands and vacuum-return heating systems. (2) Should there be a sudden drop in the Santosite residual, it is an almost certain warning of newly developed air leaks, improper functioning of the mechanical deaerator, or both. It thus acts as an indicator of mechanical defects, which can be corrected when they occur.

Full information on Santosite is contained in Monsanto Technical Bulletin O-26, "Santosite for Removing Oxygen from Boiler Feed Water." For your copy, get in touch with any District Sales Office, or write MONSANTO CHEMICAL COMPANY, Desk B, Organic Chemicals Division, 1763 South Second Street, St. Louis 4, Missouri.

District Sales Offices: New York, Chicago, Philadelphia, Boston, Cleveland, Detroit, Charlotte, Birmingham, Houston, Los Angeles, San Francisco, Seattle, Portland. In Canada: Monsanto (Canada) Limited, Montreal.

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no other pump has so much to offer...

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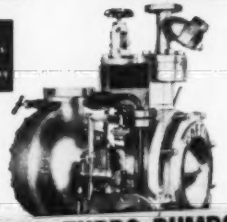
All parts made to gauge and replaceable without fitting; all parts in stock at factory with wearing parts available from agencies' stocks

High efficiency pump plus high speed two-bucket row turbine results in minimum steam consumption



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LEADING engineers in industry today look for better and more efficient equipment to cut costs AND boost production efficiency. That's why Coffin Turbo Pumps are being specified on an increasing number of jobs — *they deliver more dependable performance than any other comparable pump on the market.* Backed by more than 20 years experience, Coffin Pump specifications have been proved time after time on hundreds of installations. Check these specifications in your files the next time you want *real* pump performance — steam pressures to 850 psi . back pressures to 200 psi . . pump capacities to 500 gpm . . . discharge pressures to 1100 psi . . heads to 2400 feet . . liquid temperatures to 300°F . . .

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162

The J. S. COFFIN, JR., COMPANY

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does not necessarily indicate the specific removal method since the deposit may be bound by a substance other than the preponderant compound.

If plant operating schedule is such that turbine is frequently started and shut down, it is likely that no cleaning of any consequence will ever be required since the washing action of steam condensing on cool blading, plus the thermal and stress expansion and contraction, will effectively keep deposits to an acceptable minimum. Widely varying loads also discourage blade deposits.

Under operating conditions that encourage deposits several means of removal may be employed. The most popular method is washing with wet steam by rotating turbine at not more than 20% of rated speed and injecting boiler feedwater into steam supply. It is well to do this job through a temporary bypass around the throttle valve.

Make tests on hotwell water to indicate rate of removal and end of process. Conductivity meter may be used to advantage but allowance must be made for the effect of impure-water injection. End of process is indicated by constant conductivity readings with other conditions constant. If this means is used be sure the auxiliary oil pump is piped to a normal steam supply.

Another removal method is flyash blasting of the blades. This requires dismantling, and is costly and time-consuming although positive in results.

Another washing method is to remove the manhole plates on turbine-exhaust case and build a wooden dam across lower half of exhaust case. Fill enclosed space with water up to shaft and add suitable chemicals. Rotate turbine slowly by turning gear. A stirring device made from an electric drill may be used to agitate the solution. Visual examination and chemical tests on water will indicate end of cleaning process. This method gives good opportunity for control. If chemical additives are properly selected results are excellent.

From the steam conditions quoted it appears that this is an entirely new installation. This being the case, *ME* should keep in mind that 600-psig 825-F steam turbines should be supplied with carefully conditioned feedwater. Hence, effect of the carryover on the red-hot superheater tubes is due for careful review, and *ME* should find that this point is more critical than the turbine blading. At any rate, a good feedwater-control system is imperative, and an investment in feedwater treatment and control testing devices may be much wiser than elaborate preparation for turbine-blade deposit removal. It is generally much more advantageous to prevent trouble than to devise means of compensating for faulty operation.

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Bituminous is basic—the mainspring of America's might. Far-thinking executives—those who study existing facts, consider long-term possibilities, and prepare for emergencies—know this. So the vital decision so often made is, "build for bituminous."

Amid the uncertainties of the future is this fact: In the area served by the Baltimore & Ohio, lie vast, untapped reserves of excellent bituminous coals. They're in wide variety, and highly mechanized mines can produce them properly prepared for every requirement of modern industry.

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4th in a series describing CORAVOL results in steam systems

Type of Operation...

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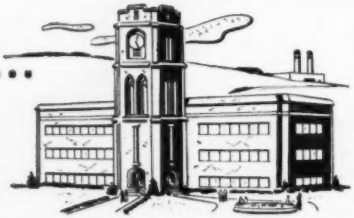

OPERATING CONDITIONS: Evaporation—300,000 lbs. per 24 hours.
Make-up—10%.
Steam and return lines: 4" to ½"—6,000 ft.

PROBLEM: Active corrosion in lines of steam system.
Extensive replacement of lines and fittings.

CORAVOL STARTED: September 1939.

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CORAVOL in your steam system (1) prevents corrosion in lines, (2) cleans out clogging rust deposits. Thus, CORAVOL *protects lines;* improves heat transfer; restores original capacity of lines and efficiency of valves and traps.

CORAVOL is *not* a boiler feed water treatment—it is designed expressly for use in steam systems. Because **CORAVOL** volatilizes and condenses with the steam, it circulates throughout your entire steam system and protects *all* zones from corrosive attack.

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*The use of CORAVOL in steam systems is covered by U. S. Patent No. 2053024. The Western Chemical Co., owner of this patent, grants licenses under which volatile AMINES purchased from other sources may be used in steam systems upon payment of royalty to Western Chemical Co.

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WESTERN CHEMICAL COMPANY

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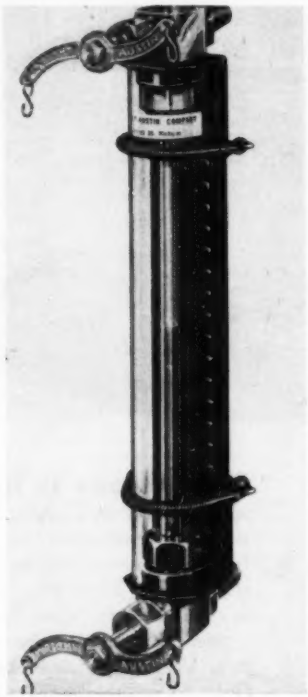
New Equipment

(*Continued from page* 150)

total maximum heat input and is supplemented by a main gas burner in the form of an annular ring that is always in place inside the furnace extension.

A special line has been developed for steam generators of 700 to 2450 lb per hr, normally employing pressure atomizing oil burners. **Preferred Utilities Mfg Co, 1860 Broadway, New York 23, N. Y.**



Gage Glass Guard E172

CADMIUM-PLATED SUPPORTS at top and bottom of gage-glass protector have a lip that fits inside the *Nuglas* front. The protector completely encloses the gage glass. A metal guard is placed at the back. The guard comes in sizes ranging from 4 in. to 8 ft in height, with glass about ¼ in. thick. **Wright-Austin Co, 315 West Woodbridge St, Detroit 26, Mich.**

Electric Hammer E194

HAMER-DRIL is an adapter which when chucked in any ¼-in. electric drill converts it into a compact efficient power hammer suitable for any purpose where rapid, moderately heavy hammering is required. It may also be operated in drill presses, or by flexible shaft, and strikes a blow per revolution of the driver. It is 6½x1⅛ in. and weighs less than 3 lb. Device is permanently lubricated by graphited grease

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2900	1850
2468	1849
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2180	1795
1894	1750
1890	1745
1868	1700

Pumping boiler-feed water 24 hours a day, at discharge pressures up to 3000 psi, is a tough job for any pump. It's a job that calls for extra stamina and endurance—for trouble-free performance year after year.

Ingersoll-Rand double-case boiler-feed pumps meet these requirements—and more. The best *proof* of their performance is their overwhelming acceptance by America's leading power producers. For they have been specified for the highest pressure boilers in use today. And over 40% of all the I-R double-case pumps sold are *repeat* orders—from users who know from experience just what I-R boiler-feed pumps can do.

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Whatever the pressure, or the capacity, Ingersoll-Rand can supply the right boiler-feed pump constructed of the proper materials. I-R engineers will be glad to confer with you at any time to help you select the type of pump that best meets your individual operating requirements.

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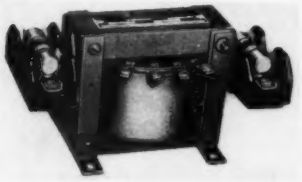
Tool is designed to take all *Rawldril* sizes from 5/32 to ⅝ in. Tool socket is a 9/16 in. hex opening, which makes adaptation of tools for special purposes very simple. By means of the flats in this hex, rotary motion under power is conveyed to drill bit while hammer blows are being delivered. This combination of compression and rotation is necessary in drilling tile or brick, etc. Rotation may be omitted when not needed. **Dril-Hamer Co, Box 158, Planetarium Station, New York 24, N. Y.**



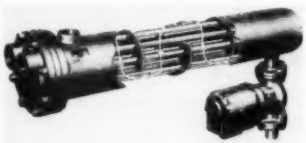
Control Transformer E210

DESIGNED SPECIFICALLY for service with industrial control equipment requiring a high, momentary inrush current, this transformer, because of its low impedance winding, offers good regulation during peak current periods. Either one- or 2-fuse and bracket assembly units may be mounted directly on the transformers to provide secondary circuit protection.

Transformers are available in 50, 100, 150, 300 va at either 50/60 or 25 cycles and 500 va at 50/60 cycles; primary voltages of 220-440, 550, 440, 380 and 220, and secondary voltages of 110 or 24. **Industrial Controller Div, Square D Co, 4041 N Richards St, Milwaukee 12, Wis.**

Filter E171

CELLULOSE RECHARGE FILTER fits Nugent filter shells. The *Nupak* is graduated in density so dirty oil under filtering passes into a large and coarse surface, then through progressively smaller fiber until particles as small as a few microns are taken out. Unit is recommended for internal combustion engines where fuel or lubricating oils enter the filter at low viscosity. **Wm W Nugent & Co, 410 N Hermitage Ave, Chicago 22, Ill.**



Water Heater E151

TANKLESS WATER HEATER for water-to-water heat transfer is made for connection outside the boiler itself. The heat comes from hot water within boiler. This hot water is pulled out from near the bottom of boiler circulation system and pumped by a booster pump over a tube bundle and through re-

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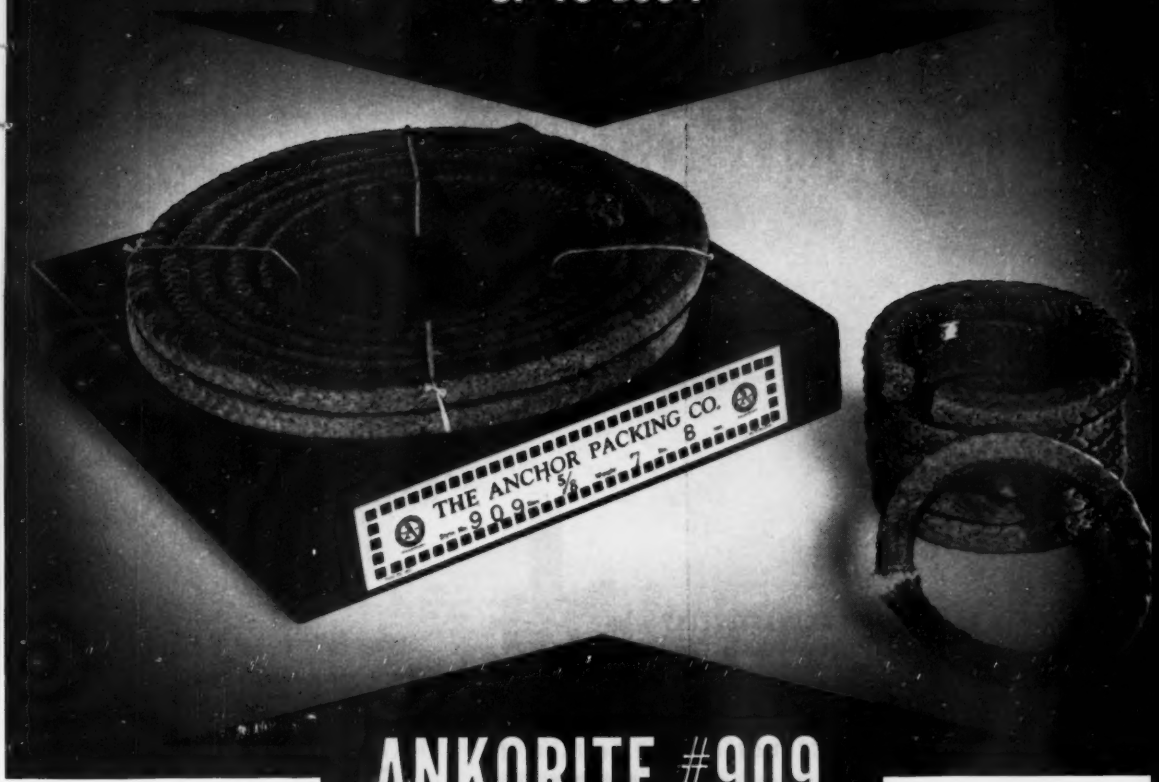
SUITABLE FOR TEMPERATURES
UP TO 500°F



ANKORITE #909

Ankorite No. 909 is a square braided asbestos packing, soft and pliable, suitable for any packing purpose on temperatures up to 500° F.

Contains no graphite and is lubricated with a high temperature white lubricant, adaptable to any food handling apparatus.

Also ideal for packing against gasoline and other hydrocarbon solvents, and on stainless steel parts.

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CLEVELAND, OHIO	MILWAUKEE, WIS.	WILMINGTON, CAL.	

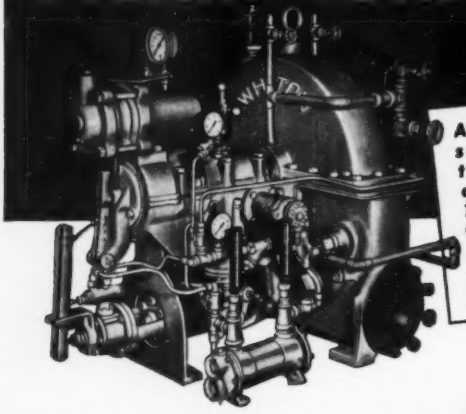
THE ANCHOR PACKING COMPANY

GENERAL OFFICES: PHILADELPHIA, PA.

FACTORIES: MANHEIM, PA., ELKHART, IND., MONTREAL, CAN.

FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE

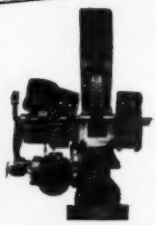
Whiton SOLID STEEL ROTOR STEAM TURBINES



Available in single stage types up to approximately 1200 HP rating. Center supported frames are available when required.

SIMPLE DESIGN FOR ACCESSIBILITY

Inlet and exhaust connections are located in lower half of casing which is horizontally split to allow easy access to all internal parts. Rotating unit including governor head may be removed without disturbing alignment of the unit.



RUGGED CONSTRUCTION FOR RELIABILITY

Whiton rotors are made from a solid steel forging with semi-circular buckets milled in the rim to give strength where it is needed. End thrust is minimized because the path of the steam is always at right angles to the shaft.

Ejector Shaft Packings assist in eliminating steam leakage to the oil reservoirs. They require a minimum of maintenance.

Whiton Turbine Bearings are horizontally split for easy removal. They consist of bronze or semi-steel shells with babbitt liners, precision fitted at the factory.

Nozzle block with reversing chamber is solidly mounted on turbine casing steam chest. It utilizes power to the utmost by redirecting steam jet with a circular action into rotor buckets.

SAFETY GOVERNING DEVICES FOR TROUBLE-FREE OPERATION

Standard equipment includes Constant Speed Governor with V-Ported Governor Valve — Emergency Governor with Independent Valve — Steel Plate Steam Strainer — Two oil rings per bearing supplemented by water cooling — Sentinel Type Casing Relief Valve — Additional accessories available as required.

Whiton Steam Turbines are under continuous rigid inspection during every step of their manufacture.

THOUSANDS OF SATISFACTORY INSTALLATIONS

Write for complete information

Whiton 1856

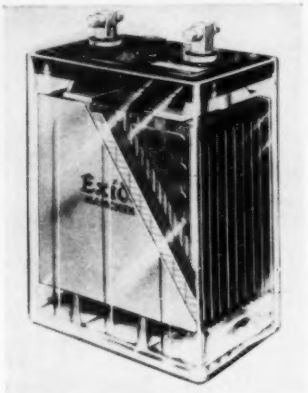
WHITON MACHINE COMPANY

NEW LONDON, CONN. U.S.A.

also makers of fine Lathe Chucks • Gear Cutting Machines • High Production Milling Machines • Centering Machines

turn piping back to top part of boiler at a point below the water line.

The water undergoing heating passes through tubes making up the tube bundle in the heater and back out to service fixtures. A hot-water control installed in hot-water service supply line starts booster pump whenever service water gets below a desired degree. The pump keeps pushing water through until service water reaches correct temperature. Capacity ranges from 200 to 2000 gph of service water, raised from 40 to 140 F in the *WU* model for boiler waters of 180, 200 and 210 F. **Bell & Gosset Co, Morton Grove, Ill.**



Storage Battery E202

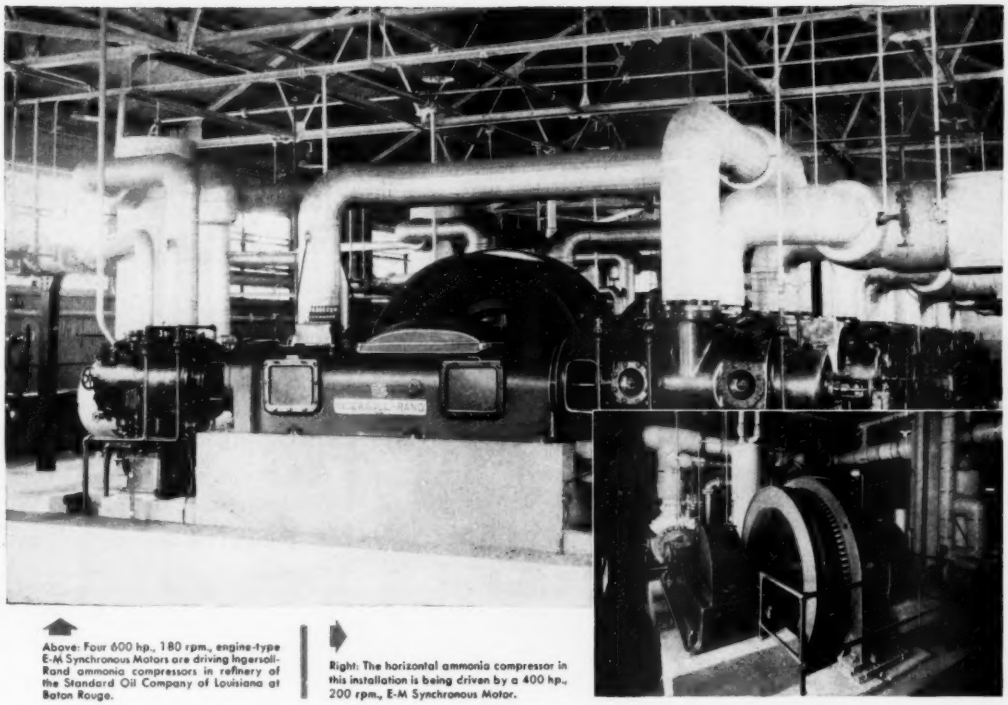
AMONG THE PRINCIPAL FEATURES of this glass-jar storage battery are long life, improved electrical characteristics, increased output per unit of space, and less weight per amp hr output. The unit is designed for service in supplying power in electric utilities, railway signaling, telephones, emergency power and lighting, and for other applications where long battery life is desirable.

Positive plate of this battery features *Manchester* type construction, consisting of a grid cast of a lead antimony alloy in which the active material is in form of pure lead buttons. *Permanized* negative plate is made of a lead antimony grid or framework and a series of vertical ribs connected by short horizontal bars. Plate separators are of specially treated wood in combination with low-resistance slotted plastic separators. Heavy terminal posts, equipped with copper inserts, aid in obtaining a high rate discharge characteristic. **Electric Storage Battery Co, 19th St & Allegheny Ave, Columbia 32, Pa.**

Intake-Snubber E174

AIR-INTAKE SNUBBERS for use on all two- and four-stroke stationary and marine engines (diesel, gas or dual fuel) also serve centrifugal and positive displacement compressors and blowers. Series *SDA* are available in pipe sizes from 1 to 30 in. inclusive.

These intake snubbers work on the same principle as exhaust snubbers. Incoming pulses of air are snubbed so oscillating flow



Above: Four 600 hp., 180 rpm., engine-type E-M Synchronous Motors are driving Ingersoll-Rand ammonia compressors in refinery of the Standard Oil Company of Louisiana at Baton Rouge.

Right: The horizontal ammonia compressor in this installation is being driven by a 400 hp., 200 rpm., E-M Synchronous Motor.

ENGINEERING *"The Most Dependable Drive"* FOR BETTER COMPRESSOR PERFORMANCE

● E-M Synchronous Motors are commonly known as "industry's most dependable constant-speed drive," a reputation that seems especially warranted by their year-in-and-year-out dependability in driving the big refrigeration compressors used in refineries and by cold storage establishments and other industries.

Behind this record of dependability are the many refinements in synchronous motor construction perfected by this company over a half century.

When engineering a compressor motor for the best possible performance under the conditions of a particular installation, E-M engineers are in a position to take full advantage of such important E-M developments as Polarized Frequency Control for proper synchronizing—power factor correction—improved motor protection against overload, short circuits, foreign materials—the use of full-voltage, automatic starting when possible. But the biggest single reason for the great performance of these motors is their extra-tough construction from their multi-layer insulation of their stator coil to their welded, rolled steel frames.

For synchronous motors that will function with full efficiency in every installation, come to this headquarters of pacemaking synchronous motor developments. Write now for our publications 175 and 181, or call in your nearest E-M field engineers.

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When You Use Masoneilan Regulators

You'll find thousands of Masoneilan Regulators in hundreds of plants giving accurate pressure reducing service in various types of application. For instance, the No. 227 regulator, illustrated, accurately maintains uniform industrial water pressures.

It stops "singing" and splashing from fixtures without cutting down flow . . . reduces strain on plumbing. In addition, the rugged construction assures long operating life with minimum maintenance. Body Ratings: 150 psi . . . Reduced Pressure Ranges: Sizes ¼" to 1" — 10-60 psi; sizes 1¼" to 1½" — 10-40; 30-60 psi; size 2" — 15-40; 30-60 psi.

Also available for air service in sizes from ¼" to 1".

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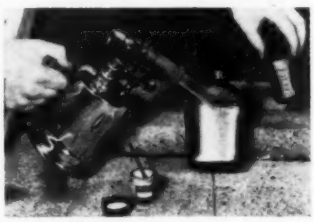
of air is smoothed out. There is no appreciable restriction of the intake pipe. On compressor intakes the snubber works best when closest to compressor. **Burgess-Manning Co, Libertyville, Ill.**

Lightning Protector E217

THYRITE LIGHTNING PROTECTOR is for service with meters and industrial power service entrances. It is rated at 0-650 v and is available for either indoor or outdoor installation on single or polyphase secondary circuits.

Single-, double- or triple-pole assemblies are enclosed in compact cylindrical aluminum cases with provision for either nipple mounting through knockout holes of meters or bracket mountings to building or pole. *Flamenol* line and ground leads extend 18-in. outside threaded nipple. **General Electric Co, Schenectady 5, N. Y.**



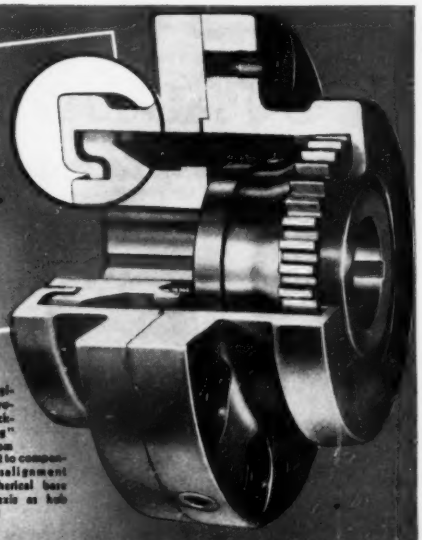
Welding Alloy E167

A HIGH SILVER ALLOY, *Eutec-Silver-Weld*, is stored in a handy pocket container, the *Economizer*, in a coil that feeds through a small hole in the top of the unit. A separate compartment in bottom of container has a jar of *Eutector Flux* for low-heat application. All torches—oxyacetylene, gas, gasoline—may apply the welding alloy. **Eutectic Welding Alloys Corp, 40 Worth St, New York 13, N. Y.**

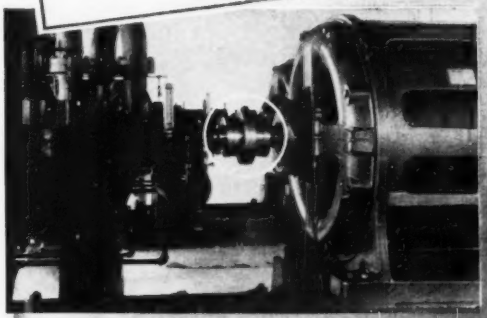
Balancing Ways E160

RUGGED-CONSTRUCTION, ball-bearing mounted balancing ways can be set up on floor or bench. They permit static balancing without centering. Work is carried on free-turning disks that have been

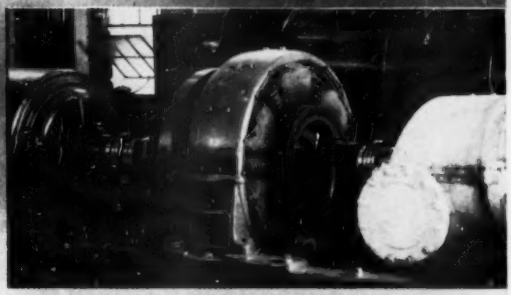
How Fast's Exclusive Metal to Metal Seal Boosts Your Plant's Production



Correctly engineered oil-protecting "rocking bearing" allows freedom of movement to compensate for misalignment because spherical bore has same axis as hub spline faces!



OIL REFINERIES insist on Fast's Couplings to *keep* their vital machinery *running*, because they know Fast's virtually *eliminate* all shutdowns due to coupling failure! This Coupling has been in service since 1931.



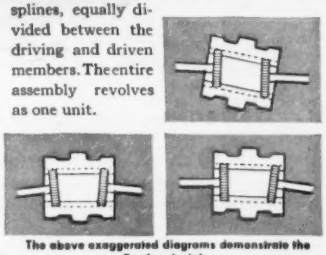
POWER PLANTS use Fast's Couplings because metal-to-metal seal, absence of perishable parts, virtually eliminate shutdowns!

YOUR production figures *go up* and *stay up* when your vital equipment is protected with Fast's Couplings, because Fast's virtually eliminate all shutdowns due to coupling failure. Fast's use no perishable parts or packing rings . . . they are the *original* gear-type coupling that *really* guards load-carrying oil from moisture, abrasive dust and grit! Fast's have *exclusive* "rocking bearing" principle that gives *sure* metal-to-metal seal.

When you specify Fast's you get years of top engineering experience, Koppers' high standard of workmanship, and unexcelled coupling service including available parts if required by change of drive, *even if your Fast's have been running for 30 years*. You save money, eliminate bottlenecks with Fast's on the job, because machine and motor life is prolonged, upkeep costs are cut, shutdown losses reduced. Find out about Fast's! Use the handy coupon, or write today for free catalog. Address: Koppers Co., Inc., Fast's Coupling Dept., 245 Scott Street, Baltimore 3, Maryland.

FAST'S COUPLINGS COMPENSATE FOR ALL MISALIGNMENT

The floating sleeve takes a neutral position. All forms of misalignment are compensated for between the lubricated faces of the splines, equally divided between the driving and driven members. The entire assembly revolves as one unit.



The above exaggerated diagrams demonstrate the Fast's principle.

KOPPERS **FAST'S** *Self Aligning* **COUPLINGS**

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Please send me your new Fast's Coupling catalog which contains all the facts and specifications.

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Company .....

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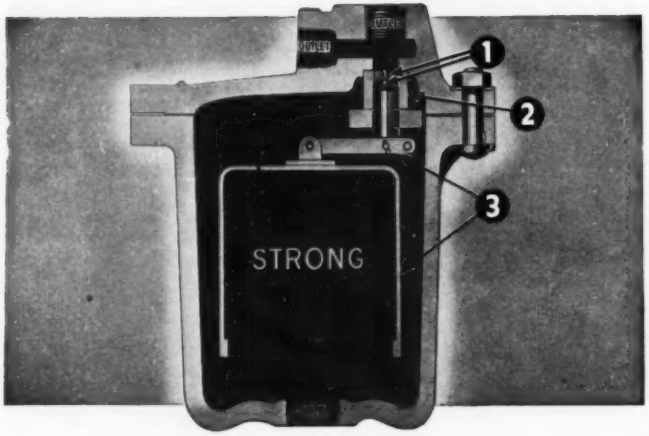
3 Reasons STRONG* Traps are easy to maintain!



Look for these three STRONG low-maintenance features in the STRONG 80 Series Inverted Bucket Trap:

1. **Anum-Metl Valve and Seat—guaranteed leakproof for one year;**
2. **Bolted-in seat design—insures tight seal, easy servicing;**
3. **Stainless steel bucket and trim.**

Compare these features with other traps!

STRONG 80 Series Trap sizes ½" to 2½", pressures to 250 lbs., temperature to 500° F. (forged steel for higher pressures).

Dual outlet simplifies piping, bottom inlet keeps trap cleaner. Years of trouble-free operation assured by super-STRONG construction.

Catalog No. 68 describes inverted, open bucket and other types of STRONG traps. Write today.

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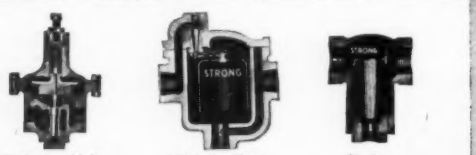


Reducing Valve | 70 Series Trap | Strainer

STRONG

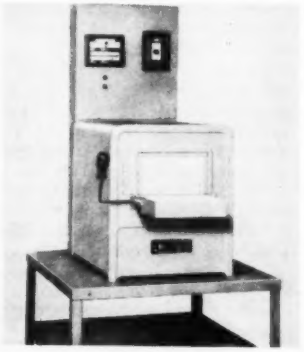
hardened and ground. Solid-end castings support these disks. These end castings are movable on two shafts to allow positioning different sizes of work.

Equipment can be supplied in four sizes, depending upon swing. They are 10 in., 20 in., 42 in. and 60 in. **Crown Industrial Products Co, 1309 W 69th St, Chicago, Ill.**

Portable Service Light E209

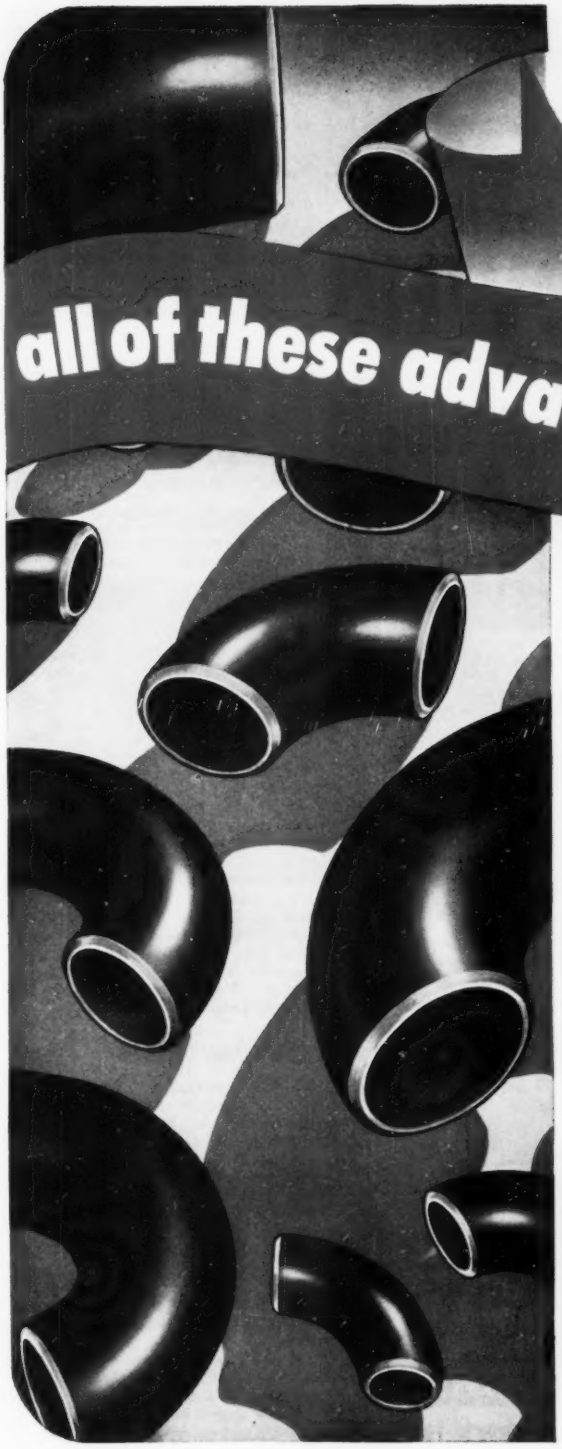
MODEL 505 features a concentrating lens and a universal mounting that permits aiming the light where it is most needed. As a result, foot-candle reading is 6½ times that of a plain bulb at a 2-ft distance.

Universal mounting permits adjustment through a full circle, horizontally and 270 deg vertically. It is equipped with a stable, non-tipping base for stand-up use. Spring-steel feet may be removed and base fastened on ceiling for overhead lighting, or handling case may be detached for service as regular portable light. Device is furnished wtih vinyl thermoplastic cord that is unaffected by oils, greases, moisture, common acids or alkalies. **McGill Mfg Co, Valparaiso, Ind.**



Laboratory Furnace E165

EXPERIMENTAL IGNITING and ashing of fuels as well as precipitate drying can be carried out in a new line of electric muffle furnaces. Type *MM* has a synchronous motor-driven variable cam that operates an on-off switch once a minute. A setting knob allows



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- SMOOTH INNER SURFACES
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all of these advantages · PLUS

. . . Globe's precision process production from Globe seamless steel tubes to Globe Welding Fittings

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Milwaukee 4, Wisconsin

Producers of Globe seamless stainless steel tubes — Gloweld welded stainless steel tubes — carbon — alloy — seamless steel tubes — Globeiron seamless high purity ingot iron tubes — Globe welding fittings.

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Power is the stuff that makes the new ROTOJET stand out from all other tube cleaners. It makes tough jobs ridiculously easy Uses less air, too. Get a powerful, rugged ROTOJET, and no other cleaner will ever satisfy you Air or water-driven models for practically any size straight or curved tubes.

ROTOJET Air-driven Motor Model 525 with swing-frame head and universal joint for 2⅝" to 3" I.D curved tubes.

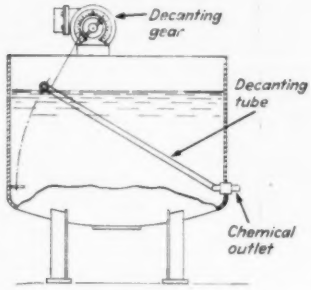
ELLIOTT COMPANY-ROTO DIVISION

153 Sussex Avenue **Newark 1, N. J.**

positioning the cam so any power input from 5% to full power may be obtained. The result is a furnace temperature anywhere from 300 F to 1750 or 2000 F. Five available models vary from 4x3x8 in. to 10x6x18 in. **Cooley Electric Mfg Corp, 38 S Shelby St, Indianapolis 7, Ind.**

Turbine Pumps E179

THESE PUMPS ARE designed for water-supply, condensate-return and boiler-feed services and for any nonviscous, nonabrasive liquids handled against moderate pressures. The pumps are available in capacities of 2 to 10 gpm and 20- to 100-ft head in water at 1750 rpm or 2 to 8 gpm, and 100- to 200-ft head in water at 3450 rpm. Impeller on stainless-steel shaft runs in two-ball bearings. **Roy E Roth Co, Rock Island, Ill.**



Chemical Feeder E154

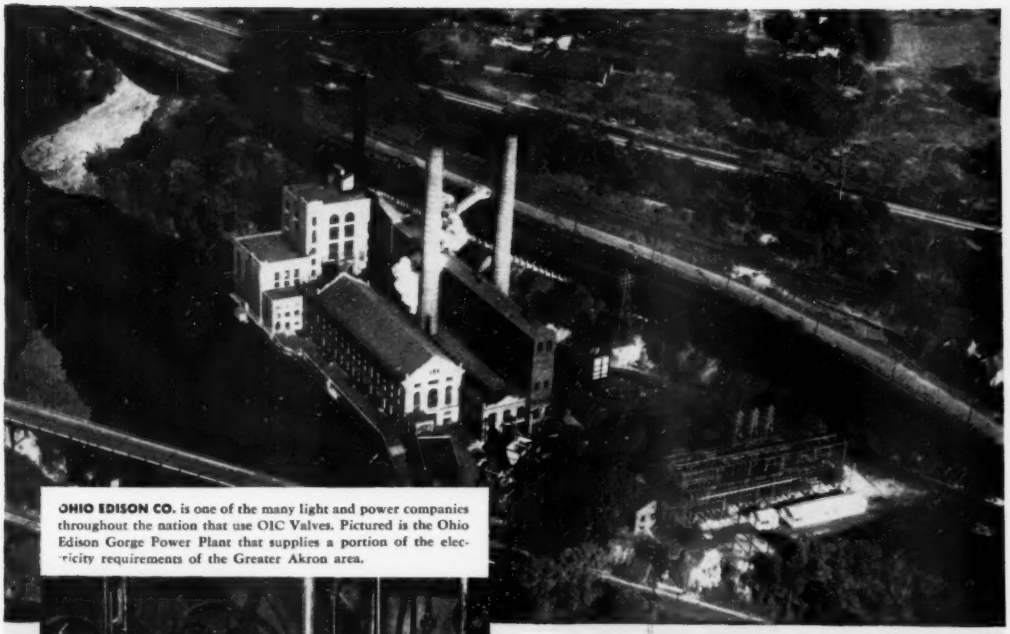
SPECIAL DECANTING GEAR automatically lowers swing-pipe decanting tube in chemical agitating tank to feed chemicals into water softeners in proportion to raw-water flow. A raw-water meter paces the operation.

A flexible cable attached to a shaped and grooved drum positions decanting tube. Rotation of drum pays off the cable and lowers tube. Oil-immersed gears drive the drum from a 1/40-hp synchronous motor operating from 110 v, 3 phase, 60-cycle current. **Worthington Pump & Machinery Corp, Harrison, N. J.**

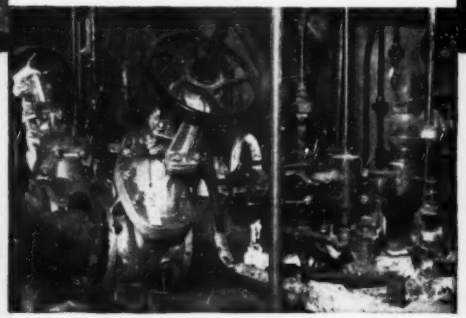
Time Switch E195

WEATHER-CHRON controls night setback of building temperature. It can be wired into the regular room thermostat circuit. In operation, the device is set to the time the building is to be warm in the morning, while shutdown time is set at the earliest time heating may be cut off in the evening. *Weather-Chron* anticipates building's need for heat and automatically changes the time heating starts each morning and shuts down each evening as the weather changes, starting heating earlier the colder it is outdoors. During the day, the regular room thermostat maintains building temperatures at the comfort level.

Where desired, a night thermostat may be used as a low limit control. On extremely cold nights, when outdoor temperatures drop below a pre-selected level, building temperature will be held at the



OHIO EDISON CO. is one of the many light and power companies throughout the nation that use OIC Valves. Pictured is the Ohio Edison Gorge Power Plant that supplies a portion of the electricity requirements of the Greater Akron area.



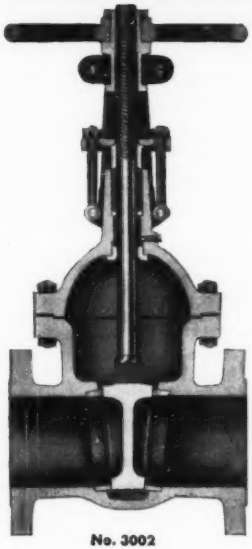
OIC
SETS THE PACE
IN VALVES

IN THE NATION'S LIGHT AND POWER PLANTS

OIC Valves are the answer to the demands of light and power companies for valves that function with absolute precision and safety for long periods of time. There are good reasons — dozens of pace-setting features that show why OIC Valves are steadily gaining nation-wide preference.

There are no flow obstructions to cause turbulence and pressure drop in OIC Valves. OIC Valves have streamlined, straight-through ports with inner walls as smooth as glass! The heavy I-beam wedge rises entirely clear of the fluid passageway. There are no recesses or pockets between the valve body ports and the seat openings. And OIC Valves are built with rugged strength to withstand the highest pressures. OIC Valves give you extra body-wall thickness . . . precisely calculated flange and gasket dimensions . . . accurate distribution of materials to prevent concentration of stresses in any one part.

OIC Valves save you money by helping you avoid extra pumping. You get *steady* pressure you can depend on! You handle your flow requirements more efficiently — more economically!



No. 3002

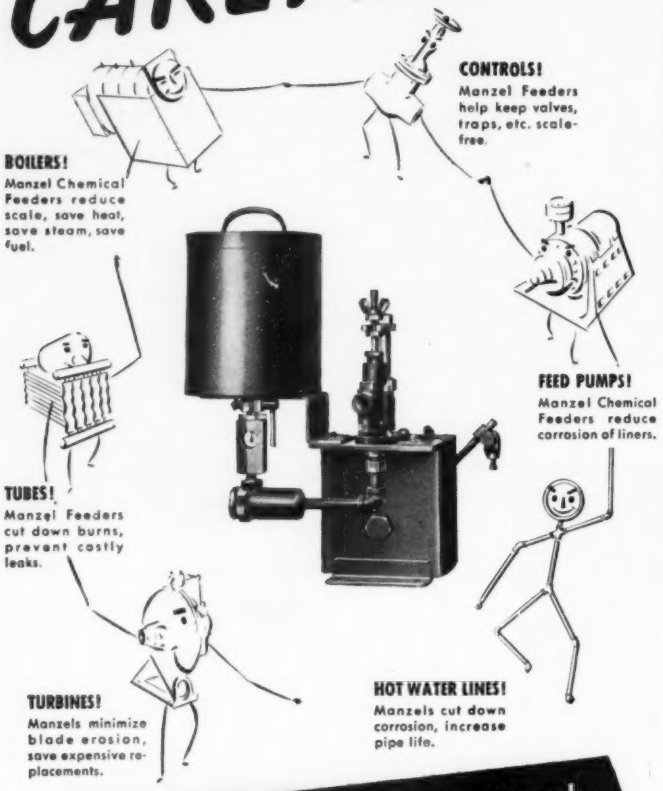
Eliminate Change-Over Difficulties with the Handy OIC Cross Reference Chart Just check the number of the valve that you wish to replace, look in the OIC Cross Reference Chart, and you will find the number of the OIC Valve to replace it. For your free copy, write to *The Ohio Injector Company, Wadsworth, O.*

OIC VALVES

0-549-10

CAST STEEL • FORGED STEEL • IRON • BRONZE

CAREFREE!


CONTROLS!
Manzel Feeders help keep valves, traps, etc. scale-free.
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Manzel Chemical Feeders reduce scale, save heat, save steam, save fuel.
FEED PUMPS!
Manzel Chemical Feeders reduce corrosion of liners.
TUBES!
Manzel Feeders cut down burns, prevent costly leaks.
TURBINES!
Manzels minimize blade erosion, save expensive replacements.
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Smart Power Engineers Use Manzel Chemical Feeders to Keep Water Correctly Treated... Automatically

● Whatever chemicals are recommended by corrosion experts, there is a Manzel Feeder to inject them automatically into your water lines in the exact proportion needed.

Manzel Chemical Feeders are available for operation from reciprocating drive, from rotary drive, from electric motor drive, and from gas or air pressure. They have been famous for many years for dependability, accuracy and economy. You, too, can reduce replacement and fuel costs, prevent breakdowns, insure profitable operation. Call your nearest Manzel representative or write...

Manzel Inc. now supplies repair parts for all models of Bowser and Torrington Lubricators.

Builders of HIGH PRESSURE METERING PUMPS Since 1898

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326 Babcock St. Buffalo 10, N. Y.

daytime level throughout the night. When the extreme low is reached, after heating has been shut down for the night, heating is started up again regardless of the time. Device also eliminates all heating in mild weather when outdoor temperature rises above 65 F. *Weather-Chron* can be added at any time and used directly with any and all existing thermostatic controls. **Weather Controls Div, Automatic Devices Co, 53 West Jackson Blvd, Chicago 4, Ill.**

Rod-Carrier E159

HANDY, on-the-job supply of welding rods fits into *Rod Hod*, an all-steel welding rod carriage rack designed for portable shop use. Unit, 15⅜ in. high x 9⅛ in. dia, is sold with a supply of 16 different sizes and types of welding rods. These rods include No. 130 *Red-Rod*, No. 140 *Production-Rod*, No. 85 *HY-Test-Rod*, No. 100 *Hard-Rod*, No. 650 *Tool-Rod* and No. 44 *Nicol-Rod*. **Marquette Mfg Co, 307 E Hennepin Ave, Minneapolis 14, Minn.**

Unit Heater E153

DIRECT-FIRED UNIT HEATER, Model 300, stands 7 ft high, is 30 in. in dia. It has a Btu output of 300,000 per hr. Completely packaged, all it needs to place it in operation are fuel, electrical and flue connections. Heated air goes directly to working area without too much velocity. **Prat-Daniel Corp, East Port Chester, Conn.**

Gas Valve E197

DESIGNED FOR RELIABLE CONTROL of natural, manufactured, mixed and liquefied petroleum gases to space and unit heaters, central, floor and wall furnaces and boilers, *B*-50 valve has no packing gland or bellows and uses low current consumption of 5 watts. It is for low- or line-voltage applications. Standard model and manual-opening model are with or without electric trip. Envelope size of valve makes it easy and simple to adapt to any gas-fired heating installation. It is of packless construction. All body parts are die-formed aluminum of high density and tensile strength.

Two small sizes are ⅜- and ½-in. inside-pipe size, diameter 2¾ in. Two medium sizes are ½ and ¾ in. inside-pipe size, diameter 3⅞ in. and three larger sizes, 1, 1¼, and 1½-in. inside-pipe sizes, diameter 5¼ in. Also available in packaged sets

(*Continued on page* 198)

PLANT EQUIPMENT NEWS

Reader Service Page for New Products and Literature

Use the handy FREE service cards for additional information on this month's new products or for copies of latest trade catalogs.

AIR CONDITIONING, HEATING, REFRIGERATION AND VENTILATING

1 **COLD STORAGE DOORS**—Jamison Cold Storage Door Co, Hagerstown, Md. 12-page catalog discusses doors for moderately low temperatures, zero and sub-zero uses and special cold-storage applications.

2 **UNIT HEATERS** — Trane Co, La Crosse, Wis. 56-page bulletin No. DS-327-B gives construction features of Trane propeller type unit heaters. Specifications are included.

3 **AUTOMATIC FILTER** — Dollinger Corp, 11 Centre Pk, Rochester 3, N. Y. 6-page bulletin describes Staynew Model A-3 4-stage automatic filters. Photos, tables and diagrams of the equipment are included.

4 **REFRIGERATION CONDENSERS** —Henry Vogt Machine Co, 1000 W Ormsby St, Louisville 10, Ky. 20-page bulletin No. RC-1 covers Vogt ammonia and freon refrigeration condensers.

5 **COOLING TOWERS AND NOZZLES**—J E Rowe, Binks Mfg Co, 3123 Carroll Ave, Chicago 12, Ill. Looseleaf catalog discusses Binks water cooling towers and industrial spray nozzles. Complete specifications and drawings are included.

BOILERS AND AUXILIARIES

6 **REFRACTORY CASTABLES**—Advertising Div, Babcock & Wilcox Co, 85 Liberty St, New York 6, N. Y. Bulletin No. R-23 on refractory castables, plastics and mortars describes the products, outlines their characteristics and indicates typical applications.

7 **PLASTIC FIREBRICK**—Dept P-2, Walsh Refractories Corp, 4070 N First St, St. Louis 7, Mo. Bulletin, entitled "Here's Longer Life For Your Furnace Linings," covers Walsh plastic firebrick.

8 **BLAST FURNACE GAS BURNERS** —Peabody Engrg Corp, 580 Fifth Ave, New York 19, N. Y. 4-page bulletin No. 500 discusses complete line of blast furnace gas burners. The bulletin includes not only blast furnace installation pictures but cross-section drawings of various other burners for waste and primary fuels.

9 **OIL-BURNING SYSTEMS**—Simplex Oil Heating Corp, 11 Park Pl, New York, N. Y. 4-page bulletin No. 123-41 describes Simplex horisontal rotary type oil burning systems. 4-page bulletin No. 123-41 discusses Simplex industry turbine type oil burning systems.

10 **DYNAMIC PRECIPITATOR** — American Air Filter Co, First and Central Ave, Louisville 8, Ky. 20-page dust control bulletin No. 277A presents the redesigned Type N Roto-Clone.

11 **JAW CRUSHERS** — Pennsylvania Crusher Co, Liberty Trust Bldg, Philadelphia 7, Pa. 12-page bulletin No. 5011 features advancements made in jaw crusher design in recent years.

ELECTRICAL EQUIPMENT

12 **MULTIBREAKER LOADCENTERS** —Westinghouse Electric Corp, P O Box 868, Pittsburgh 30, Pa. 4-page leaflet, entitled "MO-2 and MO-4 Multibreaker Loadcenters," announces the availability from stock of these additions to Westinghouse line of loadcenters.

HOW TO ORDER ADDITIONAL DATA

Be sure to fill out, completely, one coupon for each item of information you order. (See sample, right.) This gives your request authority and helps the manufacturer to address your copy completely.

When you have filled out completely one space for each item of information you want, detach along the scored lines and drop the cards in the mail.

Example

Write here number of item in which you are interested → 617

Your Company Name: Brown Mfg Co

Address: 3718 First Avenue

Portsville, Okla

Your Name: John Smith

Your Title: Power Engineer

POWER, 330 West 42nd St., New York 18, N. Y.

FILL OUT AND MAIL TODAY! NOT GOOD AFTER AUGUST 1, 1949

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POWER, 330 West 42nd St., New York 18, N. Y. 5/49

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Your Title

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Write here number of item in which you are interested →

Your Company Name

Address

Your Name

Your Title

POWER, 330 West 42nd St., New York 18, N. Y. 5/49

13 ELECTRICAL PRODUCTS — WIP News, Wagner Electric Corp, 6491 Plymouth Ave, St. Louis 14, Mo. 4-page publication, entitled "Wagner Industrial Product News," features the company's electrical products, such as motors, transformers, etc.

14 ELECTRICAL DIAGRAMS — General Electric Co, Schenectady 5, N. Y. 24-page revised bulletin No. GET-1293A, entitled "The Purpose and Use of Electrical Diagrams Supplied With General Electric Switchgear Equipments," provides a practical guide that enables those who install, operate, or maintain GE switchgear to make the best use of the electrical diagrams that are customarily supplied with the equipment.

15 FLUORESCENT LAMP BALLASTS —General Electric Co, Schenectady 5, N. Y. 20-page bulletin No. GET-922B gives complete information on installation, operation and testing of ballasts for fluorescent lamps.

16 PUSHBUTTON STATIONS — Cutler-Hammer, Inc, 294 N 12th St, Milwaukee 1, Wis. Folder, entitled "Pushbuttons Unlimited," describes complete line of standard and heavy-duty pushbutton stations.

MAINTENANCE AND SAFETY EQUIPMENT

17 HAND TOOLS — Parker Appliance Co, 17325 Euclid Ave, Cleveland 12, Ohio. Bulletin No. A44 describes hand tools for precision cutoff of copper, brass, aluminum and steel tubing, ⅛ to 2 in. OD.

18 FLOOR MAINTENANCE — Breuer Electric Mfg Co, 5100 Ravenswood Ave, Chicago 40, Ill. 24-page booklet, entitled "The Tornado Method," covers practically every problem of plant and institution floor care and maintenance. It describes equipment necessary, steps to be followed with both old and new floors of every type and composition, and includes a stain removal chart.

19 HOLE SAWS AND REPLACEMENT BLADES—Misener Mfg Co, 202 Walton St, Syracuse 2, N. Y. 6-page catalog, Form No. 149, describes complete line of Misener hole saws, replacement blades and parts.

20 METAL CUTTING TOOLS — Chicago-Latrobe Twist Drill Works, 411 W Ontario St, Chicago 10, Ill. 8-page folder, Form No. 51, illustrates all of the popular items of drills, reamers, carbide tools, etc., together with their respective list numbers that are included in the Chicago-Latrobe line of metal cutting tools.

21 AUTOMATIC OILERS—Trico Fuse Mfg Co, 2948 N 5th St, Milwaukee 12, Wis. Bulletin No. 31 features a new principle of visible, automatic lubrication for solid, wick and waste-packed bearings.

MATERIALS HANDLING

22 MAGNETIC SEPARATORS—Erie Mfg Co, Erie, Pa. 8-page catalog contains full information on plate magnets, magnetic pulleys, magnetic drums and pipeline traps.

23 ELEVATOR EQUIPMENT — Otis Elevator Co, 260 Eleventh Ave, New York 1, N. Y. 16-page booklet No. B-735(9410) describes Otis electronic signal control elevators. 4-page bulletin No. 2054-9410 presents Otis electronic touch button landing fixture. 6-page reprint No. B-2069, entitled "Moving Stairways" by Carl J Kroepel, discusses the subject thoroughly. Bulletin No. B-672(8450) covers operation of Otis oil buffers.

24 EARTH MOVER — R G LeTourneau, Inc, Peoria, Ill. Broadside No. TP-147 gives informative data on the new electric-control C Tournapull. In addition to presenting specifications, the broadside features action photos showing this Tournapull working in mud, in tough sand, on steep grades, and making job-to-job moves over the highway.

25 WIRE ROPE SLINGS—A Leschen & Sons Rope Co, 5909 Kennerly Ave, St. Louis 12, Mo. 12-page bulletin No. FLS-49 describes flat-laced wire rope slings.

26 CONVEYOR AND ELEVATOR BELTING — New York Belting & Packing Co, 1 Market St, Passaic, N. J. 24-page manual presents engineering characteristics on all types of belts manufactured by the company for such operations as coal and iron mining, food processing, packaging, handling of grain, stone, sand, gravel, soda ash finished cement, foundry sand and hot materials.

MECHANICAL TRANSMISSION

27 TRANSMISSION EQUIPMENT — Patron Transmission Co, 129 Grand St, New York 13, N. Y. 192-page catalog supplies complete data, including prices, on over 6000 items of the company's broad line of power-transmission equipment and conveyor supplies on hand for immediate delivery.

28 BALL BUSHINGS — Thomson Industries, Inc, Manhasset, N. Y. 12-page engineering catalog covers both the Precision Series A ball bushings as well as the new series B bearings that have just been put out on the market.

29 SPEED REDUCERS — Farrel-Birmingham Co, 344 Vulcan St, Buffalo 7, N. Y. 44-page bulletin No. 449 contains complete information about the company's line of speed reducers.

METERS AND INSTRUMENTS, MECHANICAL

30 MULTI-POINTER GAGES—Bailey Meter Co, 1050 Ivanhoe Rd, Cleveland 10, Ohio. 8-page bulletin No. 163-B describes latest developments in Bailey multi-pointer gages.

31 FLOWMETER MANUFACTURE—Penn Industrial Instrument Corp, 2116 N Seventeenth St, Philadelphia 32, Pa. 8-page bulletin No. 500 shows various steps in manufacture of Hays-Cochrane electric and mechanical flowmeters.

32 DIESEL ENGINE PYROMETER—Bristol Co, Waterbury 91, Conn. 12-page bulletin No. P1239 describes approved Navy and commercial type diesel engine pyrometers and thermocouples for all types of diesel engines.

33 RECORDING AND CONTROLLING INSTRUMENTS — Bristol Co, Waterbury 91, Conn. Bulletin No. 138, entitled "Industrial Waste Disposal," describes application of the company's automatic pH recording and controlling instruments and recording flowmeters to industrial waste disposal operations.

(*Continued on page 196*)

FIRST CLASS
PERMIT No. 64
(Sec.510,P.L.&R.)
NEW YORK,N.Y.

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

4c. Postage Will Be Paid by—

POWER
330 West 42nd Street
New York 18, N. Y.

FIRST CLASS
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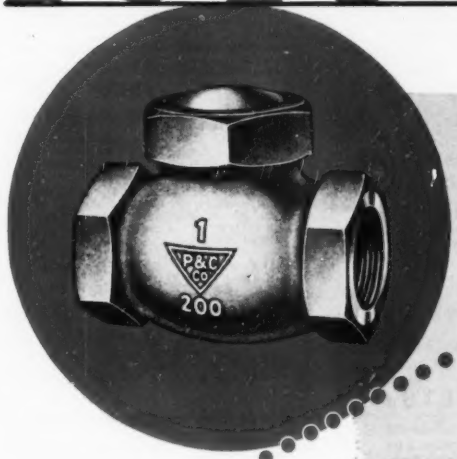
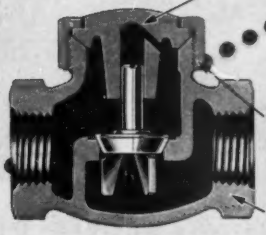
R·P&C

BRONZE LIFT CHECK VALVES

designed and built to take ***PUNISHMENT***





1 CAP—forms an efficient beveled joint with the body. The integral disc guide has long contact with the disc stem for perfect alignment and resulting free movement and positive seating. It also cushions disc movement.

2 UNION NUT—heavy and rugged. Can be removed and replaced without danger of distorting the body or weakening threads.

3 BODY—has heavy section at cap joint and end hex with long contact end threads. Seat is integral with body.

THESE BRONZE LIFT CHECKS—rated 200 pounds and 300 pounds—are especially suited to prevent back-flow on high velocity line or where flow is pulsating. Shut-off is quick, positive and tight. For use in horizontal lines only. • (On low or moderate velocity lines, R-P&C swing checks are recommended.) • Get in touch with the nearest R-P&C District Office or R-P&C Distributor for information about Check Valves.

ACCO

Reading, Pa. • Atlanta • Baltimore • Boston • Chicago • Denver • Detroit
Houston • New York • Philadelphia • Pittsburgh • San Francisco • Bridgeport, Conn.

R-P & C VALVE DIVISION
AMERICAN CHAIN & CABLE

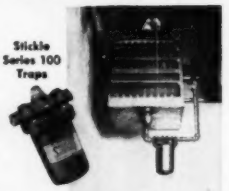
TRADE MARK

READING-PRATT & CADY VALVES

Full OPERATING ECONOMY

Positive Drainage of Processing Units . . . Increased Boiler Capacity and More Uniform Operating Pressures . . . Greatly Reduced Fuel Consumption . . . PLUS Other Operating and Maintenance Savings

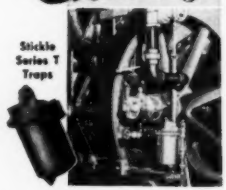
Stickle Drainage for steam processing equipment provides for completely efficient unit performance. Stickle Traps allow heating spaces to be filled continuously with live steam. Condensate is removed as rapidly as it accumulates. Air is eliminated with condensate. Stickle Open Float principle supplies positive trap operation, and provides construction simplicity that frees traps of mechanical difficulties. Made in series designs for various drainage applications and specific conditions of operation.



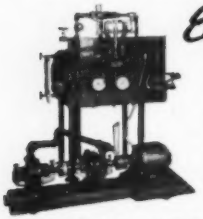
STICKLE SERIES 100 TRAPS, designed for straight-in-line installation, meet the requirements of all types of smaller equipment operating at medium to high pressures. Capacity range, 250 to 5,000 lbs. per hour. Described in Bulletin No. 115.

STICKLE SERIES AE TRAPS have four times the capacity of standard traps and handle drainage for a wide range of industrial processing, with equipment operating at medium to high pressures. Capacity range, 5,000 to 40,000 lbs. per hour. See Bulletin No. 315 for data.

STICKLE SERIES 50 TRAPS are specifically designed to handle condensate from processing units operating at high pressures having variable conditions of pressure and variable rates of condensation, such as submerged coils in large open tanks. Capacity, eight times that of standard traps, with capacity range of 18,000 to 46,000 lbs. per hour. Ask for Bulletin No. 515.



STICKLE SERIES T TRAPS have a wide range of application for draining units operating at medium and low pressures and on vacuum. The series includes radiator traps, small to large utility traps, and traps of extra large capacities. Bulletin No. 415 supplies complete information.



Eliminate Waste OF BTUs

Unit trapping of equipment combined with Stickle Differential Drainage and Boiler Return System permits all condensate to be returned directly to boilers at a temperature only a few degrees lower than steam at operating pressure. This represents 85 per cent, or more of boiler supply. Fuel saving, on average installation, about 15 per cent, with a like ratio of increase in boiler capacity. Working pressures more uniform; flash steam waste eliminated; and pumping costs and boiler and steam line maintenance reduced. Ask for Bulletin No. 250.

STICKLE STEAM SPECIALTIES COMPANY
2265 Valley Avenue, INDIANAPOLIS 18, INDIANA

Successfully Serving for More than 40 Years Paper Mills, Food Processors, Textile and Hosiery Mills, Laundries and Other Manufacturers Using Steam for Industrial Processing

STICKLE EQUIPMENT

STICKLE DIFFERENTIAL AND BOILER RETURN SYSTEMS • STICKLE OPEN FLOAT STEAM TRAPS • STICKLE REGULATING AND REDUCING VALVES • STICKLE OPEN COIL FEED WATER HEATERS AND PURIFIERS • STICKLE OIL AND STEAM SEPARATORS STICKLE TEMPERATURE CONTROLLERS AND OTHER SPECIALTIES

PIPING, FITTINGS, VALVES AND SPECIALTIES

34 INSULATED PIPING DISTRIBUTION SYSTEMS—Dept A23, RicwiL Co, Union Commerce Bldg, Cleveland, Ohio. 32-page booklet, Section 480-2, discusses such subjects as layout of the route, methods of estimating steam loads, steam flow charts and tables, properties of steel pipe, properties of saturated steam, etc. 40-page booklet, Section 480-3, reproduces actual drawings used in a wide variety of insulated piping installations.

35 THERMOSTATIC STEAM TRAPS—Sarco Co, Empire State Bldg, New York 1, N. Y. 8-page bulletin No. 250-A covers Sarco thermostatic steam traps for industrial service.

36 FORGED-STEEL STRAINERS—Edward Valves, Inc, East Chicago, Ind. 4-page bulletin No. 712 gives construction and design details of Fig. 128 forged-steel strainers.

37 LIGHTWEIGHT FLEXIBLE HOSE—American Ventilating Hose Co, 15 Park Row, New York 7, N. Y. 14-page catalog No. 30 discusses features of Flexaust hose. Typical applications and installation data are included.

PRIME MOVERS AND ACCESSORIES

38 DIESEL ENGINES—Dept OE, Benjamin's for Motors, 2124 Mill Ave, Brooklyn 10, N. Y. 32-page reprint gives complete specifications on every commercially manufactured diesel engine, including horsepower ratings, model numbers and other important details.

39 DIESEL ENGINES—Nordberg Mfg Co, Milwaukee 7, Wis. 6-page bulletin No. 165 discusses construction of Nordberg Type 4FS-1 4-cycle, one-cylinder, 4½x5¼ in. diesel engines.

40 GAS ENGINE DRIVEN PLANTS—Kato Engrg Co, Mankato, Minn. Catalog sheet, Form No. 1349, describes construction of Katolight gas engine driven plants.

WELDING

41 ARC WELDING—Lincoln Electric Co, Cleveland 1, Ohio. 4-page bulletin No. 464 covers Aluminweld, a 5% silicon aluminum alloy shielded arc electrode for welding aluminum in any form, and Aerisweld, a shielded arc electrode for welding bronze, brass and copper.

42 WELDING CONTROL—DV Welding Controls, Oakland 11, Calif. 4-page bulletin describes operating features of improved automatic start-stop dc welding control.

43 ARC WELDING—Lincoln Electric Co, Cleveland 1, Ohio. 8-page pamphlet, entitled "It's Welding Time," has photos and drawings that show how plants in all parts of the country are using arc welding.

OTHER EQUIPMENT

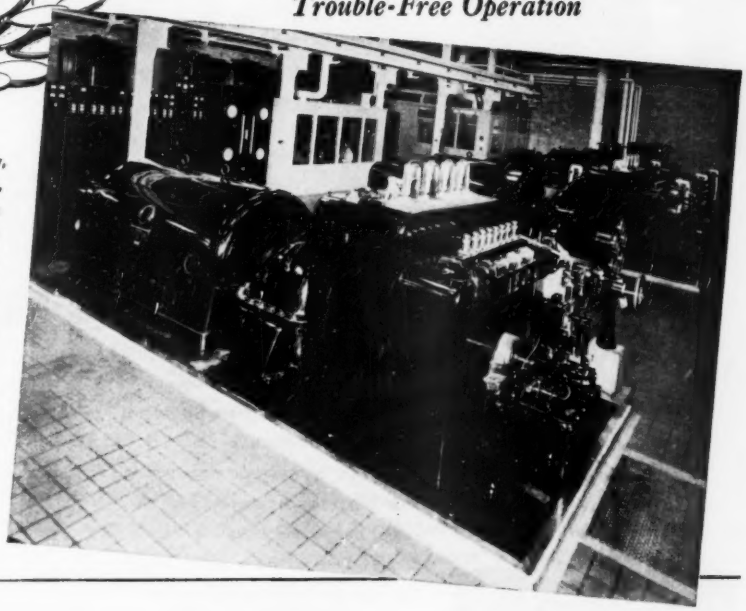
44 COMPANY HISTORY—Dowell Inc, Tulsa 2, Ohio. 20-page booklet tells how Dowell Inc, a subsidiary of Dow Chemical Co, has become a leader in a highly specialized field—acidizing oil and gas wells to increase production. This booklet also discusses chemical removal of scale and sludge from industrial equipment.

45 WALKWAYS AND LOADING RACKS—Black, Sivalls & Bryson, Inc. 44-page catalog No. 54, section 6, part 1, discusses BS&B Safwalk walkways and loading racks.

46 SWITCH MODELS—Unimax Switch Div, W L Maxson Corp, 460 W 34th St, New York 1, N. Y. Supplement to Unimax precision switch selector describes new Unimax switch models recently made available. The new catalog section, No. 492, provides complete electrical and mechanical performance data, dimensions and features of the new type.

COST-CUTTERS YOU CAN DEPEND ON!

Worthington Turbine-Generators Set The Pace For Economical, Trouble-Free Operation



Two Worthington 2500 kw, 3600 rpm, 13,800 volt, 3-phase, 60 cycle Turbine-Generator Units at the Kaiser-Frazer plant in Willow Run, Michigan. They operate on steam at 250 lb. initial pressure, 470° F. total temperature, and exhaust at 27½" vacuum. Steam is automatically extracted at pressures from 15-50 lb. Installed in 1941, these Worthington Units supply both electric power and extracted steam for plant heating.

Worthington builds Turbine-Generator Sets in sizes up to 7500 kw, and in all types—including straight condensing, straight non-condensing, extraction, mixed pressure, mixed pressure extraction, low pressure and high back pressure.

Throughout industry these units are generating lower cost power, requiring only minimum maintenance, chalking up records of 99% — and better—for continuous operation, year after year.

IN YOUR OWN PLANT

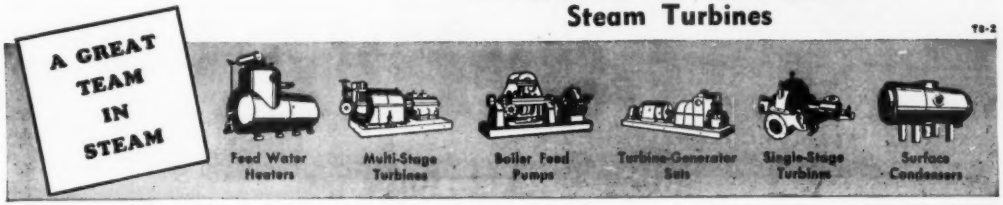
Worthington engineers will be glad to study your power requirements, and to give you an estimate of the savings possible with the Worthington Unit that best meets your particular needs.

For further details proving *there's more worth in Worthington*, call your nearest Worthington District Office, or write to *Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, N. Y.*

WORTHINGTON

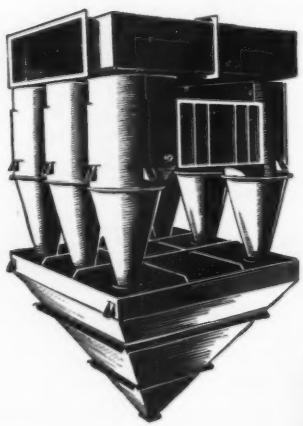
Steam Turbines

TB-2



1 Afterthoughts are Costly in fly-ash COLLECTION

Breeching-layout design often does not provide enough space for an *efficient* fly ash collection system—where original engineering has failed to look ahead. Every boiler plant, from here on, should pre-vision the realistic need for fly ash collectors—*some day*. You may be planning for present needs or for future contingencies. Whichever it is, Buell can offer sound, experienced counsel, both on actual design and installation, and on the economics of space planning. Call in a Buell engineer, and satisfy yourself that a Buell system will do your job of fly ash collection most efficiently, or write for Buell's factual, new 32-page catalog today. Buell Engineering Company, 10 Cedar Street, New York 5, N. Y.



buell

Engineered Efficiency in DUST COLLECTION

47 MINERAL WOOL INSULATION—Industrial Mineral Wool Institute, 441 Lexington Ave, New York 17, N. Y. 26-page Commercial Standard No. CS-105-48 defines five forms of mineral wool commonly used in low-temperature applications. Recommended specification requirements for thermal conductivity, density, moisture sorption, corrosive properties, odor and fire resistance of mineral wools are given.

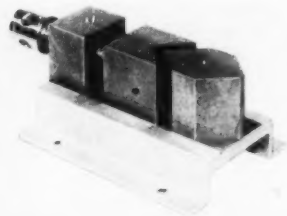
48 SLUDGE REDUCER — Maxfal Chemical Co, 33 W 42nd St, New York, N. Y. 6-page folder tells how Fusol No. 1 steps up heat efficiency in oil burning systems. 6-page folder describes Fusol No. 3 for diesel engine efficiency.

49 ELECTRONIC COUNTERS AND TIMERS—Potter Instrument Co, 136 Roosevelt Ave, Flushing, N. Y. 4-page condensed catalog is a brief guide to the company's line of high-speed electronic counters, scalers, counter chronographs and special electronic frequency measuring and computing equipment.

New Equipment

(*Continued from page* 194)

that include the new 7-70 snap-action thermostat, a 9-va transformer and thermostat cable. **General Controls Co, 801 Allen Ave, Glendale 1, Calif.**



Busbar Bender E239

ALTHOUGH DEVELOPED for service in large power plants, the device is readily adaptable for use in shop and field. Over-all height of bender is 18½ in., while its total weight is 110 lb. It is capable of bending busbar up to 4 in. wide and ¼ in. thick. **Flexo Machines Co, 456 N Aberdeen St, Chicago 22, Ill.**

Feedwater Control E196

WEIGHT-O-WATER uses the weight of water as a force to operate the feedwater valve. Device consists of an 18-in. balance chamber, hung on a spring to permit its rising and lowering, and is connected to the boiler through flexible copper tubing at the top.

Bottom connection to boiler consists of piping with two swivel joints. Up-and-down movement of the chamber actuates a control valve that requires a force of less than one-half pound to actuate. Opening and closing of the valve controls amount of water fed to boiler. A drop of water level in the boiler causes water to flow from chamber back into the boiler. This lightens weight of the chamber, and since it is suspended on a spring, the chamber rises and opens the valve to feed more water to

DO YOU NEED A

LARGER

"UNI-MATIC"

OIL PURIFIER?

THE NEW No. 67 HAS A CAPACITY OF 450-550 G.P.H.

Now it is possible to obtain a larger De Laval "Uni-Matic" Oil Purifier than has ever been available before. The new No. 67 has a capacity of approximately 450 gph. (Navy rating) when purifying turbine oil. On other oils, the capacity of the No. 67 will vary from 200 to 550 gph. depending on the viscosity and temperature of the oil being purified.

A De Laval "Uni-Matic," whatever its size, is a complete oil purification unit consisting of a De Laval centrifugal machine with integral pumps, and, where desired, with heater. ***All*** De Laval machines make most effective use of centrifugal force to remove both of the chief contaminants of oil—***water*** and ***dirt***—and do it so completely that bearings receive the ultimate in protection, and fuel oil yields maximum B.T.U. value.

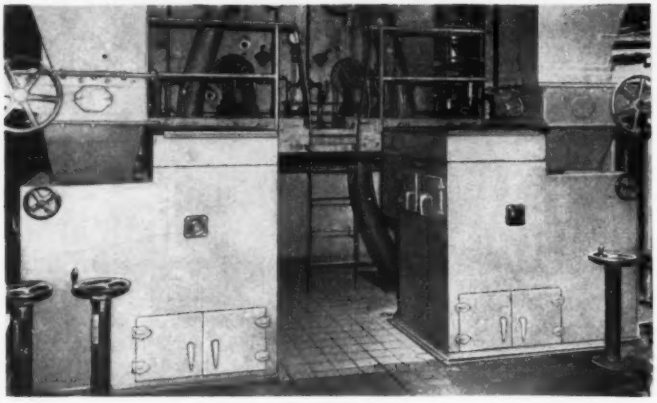
● ***Write for Bulletin MU-1.***

De Laval

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

LUBRICATING OIL PURIFIERS

ON GUARD.. TO KEEP COAL COSTS DOWN



At ROCKLAND LIGHT AND POWER COMPANY'S NEW HUDSON PLANT

Maximum operating economy, in spite of increasing power costs, was the primary consideration in the design of the new 120,000 kw. (ultimate capacity) steam plant of Rockland Light and Power Co., at Tomkins Cove, N. Y.

The first unit, of 20,000 kw., in operation since March, 1949, is one of a series of standard plants — designed by Burns and Roe, Inc., Engineering Consultants, to realize the ultimate in economy from both plant layout and equipment. Richardson Automatic Coal Scales were selected to assure accurate records of coal consumption.

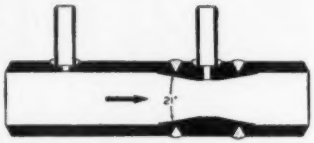
Two Model EE39, 200-lb. units, one right hand and one left hand, each with 15T/Hr. capacity, automatically weigh coal from 290-ton overhead bunker to pulverizers. Scales were supplied complete with electric timer type "no-flow" alarm to warn of any interruption in flow of coal; dustproof, siftproof, double rack-and-pinion, ball-bearing gates to control flow; and dust-tight, flexible inlet connections to seal joints and eliminate pressure on scales.

For over 40 years Richardson Automatic Coal Scales have been helping central stations and industrials eliminate preventable coal waste and produce more power at less cost . . . a good reason for calling on Richardson when you plan to modernize your present plant or build a new one.

For further details on Richardson Coal Scales, *write for Bulletin No. 1143-P.*

RICHARDSON SCALE COMPANY, Clifton, N. J.
ATLANTA • BOSTON • BUFFALO • CHICAGO • MINNEAPOLIS • WICHITA
NEW YORK • OMAHA • PHILADELPHIA • SAN FRANCISCO • DETROIT • PITTSBURGH • MONTREAL • TORONTO

boiler. Then as water level rises, flow from boiler to chamber increases the latter's weight and it starts closing the valve. **J A Campbell Co, 645 East Wardlow Road, Long Beach 7, Calif.**



Venturi Tube E231

VENTURI-TUBE ASSEMBLIES for line sizes between ¾ and 3 in. are supplied with welding ends, and stub-end welding nipples for measurement connection. They can be furnished in steel, stainless steel, monel, brass, bronze, or any other metal that can be obtained in tubular and bar form, and that can be readily welded or brazed. Manufacturer says tubes are particularly useful where line fluid velocities are so high that excessive differential range is required with an orifice plate, or where solids in suspension in the line fluid tend to deposit in the space immediately ahead of or after an orifice, or on the orifice plate itself. **Republic Flow Meters Co, 2240 Diversey Parkway, Chicago 47, Ill.**

Service Light E247

PORTABLE, greaseproof service light has a convenient outlet built into the molded bakelite handle. The outlet serves as a handy tap for power tools, soldering irons or additional lights.

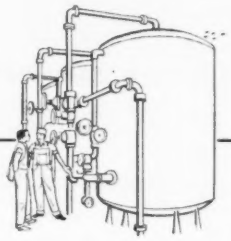
No. 5025 service light is equipped with 25 ft of vinyl thermoplastic cord and plug. **McGill Manufacturing Co, Valparaiso, Ind.**

Packing E198

RAINS PACKING eliminates lantern or seal rings in a stuffing box. Manufacturer says it can be used on any piece of mechanical equipment having a standard stuffing box, on either rotating or reciprocating rods, stems or shafts, and on pressures to 10,000 psi. Lubricant-impregnated wood acts as reservoir of lubrication, which creates osmotic action, causing a continuous seepage of lubrication on rod or shaft. A high sealing capacity is obtained by special angular shape of wood-metal units, because they arrange themselves around rod or shaft, forming a bearinglike wearing surface. It is manufactured in standard packings for all ordinary services, superheat packing for temperatures up to 1200 F, and special packings for alcohol, gas, oil, etc. **Rains Wood Metal Packings, West 900 Broadway, Spokane, Wash.**

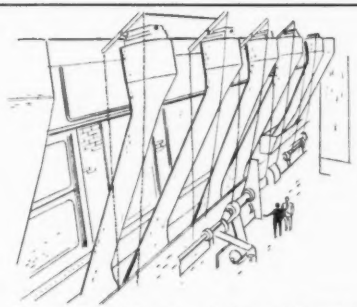
HERE IS THE Starting Point OF HALL BOILER WATER CONDITIONING

When Hall Laboratories recommends procedures for Boiler Water Conditioning, these procedures are "tailored" to fit *your* plant. Hall service starts, therefore with a study of your plant, considering especially (1) raw water supply, (2) facilities and requirements for pre-treatment of water, (3) steam generating equipment, and (4) steam uses.

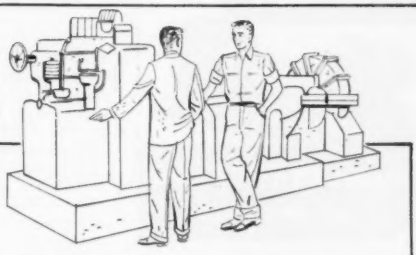


Softening and other forms of raw water pre-treatment are often desirable and sometimes absolutely necessary. Hall considers these from the point of view of results and costs *in your specific case*, and helps you to get best results from equipment you already have.

The treatment needed to give you the kind of water you *want* depends first of all on the kind of water you *have*, so samples of water from all sources available to you are carefully analyzed in our Pittsburgh laboratories.



Thorough knowledge of your boilers and of pre-boiler equipment is essential in setting up a program of boiler water treatment. Type of boiler, pressure, capacity, kind of firing, nature and extent of load variations, and dozens of other facts must be considered, as all of them have a bearing on boiler water treatment.



Hall Laboratories studies the uses of steam in your plant, for the nature of these uses determines the *quality* of steam you need, and steam quality must be taken into account in prescribing the treatment best suited to your plant.

Every plant which has Hall service gets *individual attention* — which is one reason why small as well as large plants find this service profitable. Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

HALL LABORATORIES, INC.

(A Subsidiary of Hagan Corporation)

CONSULTANTS ON
INDUSTRIAL WATER TREATMENT
HALL SYSTEM OF BOILER WATER CONDITIONING
INDUSTRIAL WASTE RECOVERY AND DISPOSAL

For STRENGTH specify

TRI-LOK

RECTANGULAR

OPEN STEEL FLOORING

The locked-in strength of Tri-Lok enables it to stand up under heavy loads—even on long spans. No rivets, bolts, or welds are used in the construction of Tri-Lok; this feature eliminates the possibility of loose joints.

Tri-Lok is also available in Diagonal, or Super-Safety U-type Flooring, and in Stair Treads of all types. Write for Bulletin KM 1140.

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National Distributor for the Tri-Lok Company

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IMO PUMPS

PERMIT DIRECT DRIVE AT ANY SPEED

The IMO pump can be connected directly to turbines, motors or other machinery without the use of reduction gears.

Operated at high speed, it is exceptionally small and compact in proportion to its capacity.

IMO pumps can be furnished for almost any capacity and pressure required for pumping oil, hydraulic control fluids and other liquids over a wide viscosity range.

For further information send for catalog I-138P.

IMO PUMP DIVISION of the DE LAVAL STEAM TURBINE CO. TRENTON 2, NEW JERSEY

Power News

(*Continued from page* 138)

tions of the engine and a photograph will be found in the Plant Equipment News department, page 146.

In addition to viewing the new model on the test beds, visiting editors made a tour of the plant and development laboratories. Special interest was displayed in the precision manufacture of fuel-injection equipment, in the gaging and inspection methods employed to insure control of quality, and in the development shops and laboratories.

Use of Reheat Boilers Justified by Economies

Present costs of fuel and labor justify larger investments in equipment to improve operating economy, said Paul R Loughlin, chief staff engineer, Babcock & Wilcox Co, in discussing the increased use of reheat boilers in central stations at the 28th Annual Massachusetts Safety Council. Citing the conditions leading up to this development, he pointed out that B & W now has 10 reheat units in various stages of design, fabrication or erection and many more are being considered. It is expected that the trend to large reheat units will continue.

Discussing other features of current boiler practice, Mr Loughlin dealt with the trend to increase the range of steam-temperature control and the means for doing it, and widespread successful use of chemical cleaning on the water side of boilers. He pointed out that larger high-temperature and high-pressure boilers are being installed in central stations primarily because initial investment per unit of output decreases as size increases. Emergency outage of such units requires operation of less-efficient equipment which, coupled with high cost of shutting down and starting up a large unit and the loss on the idle investment, has focused attention of operators and designers on the importance of minimizing outage possibilities. Careful control of feedwater and boiler-water conditions has accomplished much in avoiding troublesome deposits, which cause tube failure, and continued improvement in tube-expanding equipment and methods helps to eliminate leakage at tube seats in saturated pressure parts. Another development cited is a special casing design permitting operation without an induced-draft fan, increasing efficiency slightly, reducing fan power and eliminating induced-draft-fan maintenance cost and outage time.

Addressing more than 800 dealers and distributors from the U. S., Canada and Great Britain at 22nd annual national **Iron Fireman** convention in Cleveland, C T Burg, vice-president of the company, predicted 24% more business this year and announced new-product developments in their line of automatic heating and power equipment for coal, oil and gas fuels.

CONTROL

Scale and Corrosion in Power Plant Equipment

WITH

Newly Perfected

Water Conditioning Chemicals

Recently developed applications of the newer colloids and surface-active agents in Wright Chemicals for power plants result in **improved** water conditioning — **positive** scale and corrosion control. Wright Chemicals contain 100% soluble, available chemicals—no waste or inert matter—insuring increased operating efficiency and reduced cost.

Boiler Water . . .

Corrosion and scale-forming compounds in boiler water can be controlled with Wright Chemicals.

Steam and Condensate Lines . . .

Steam and condensate lines can be properly protected by using Wright recommended formulas.

Cooling Jackets . . .

Efficiency of cooling jackets can be substantially increased by preventing corrosion and scale deposits on heat transfer surfaces.

Wright improved chemicals are the result of intensive study and research by men with years of experience in the development, production, application and control of water-conditioning chemicals.

Wright has no one cure-all to solve all problems. Each receives individual treatment. The Wright field engineer, who will call on you upon request, will obtain all necessary information and samples for examination in the modern Wright laboratory. Analyses are interpreted in view of supplemental information received, and recommendations made in the form of a proposal. Clients are provided with regular laboratory service as a periodic check upon conditions.

Send for new folder giving full details.

Wright CHEMICALS

WRIGHT CHEMICAL CORPORATION

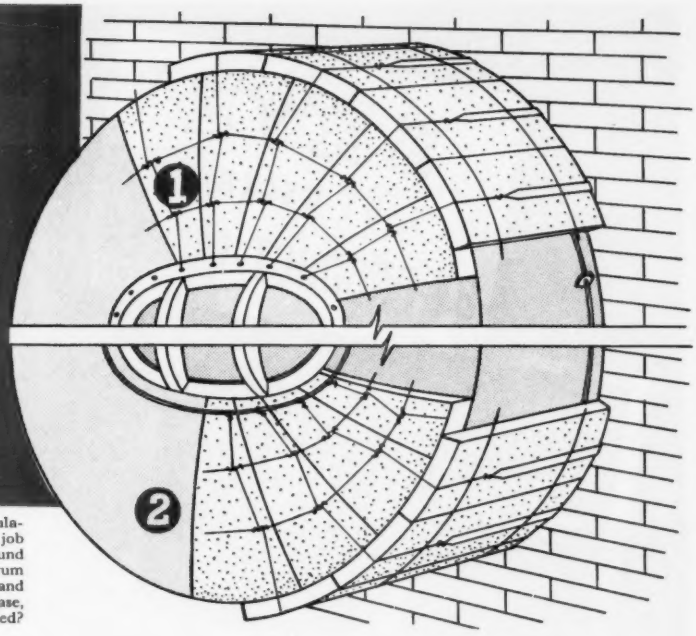
Specializing in Water Conditioning

GENERAL OFFICES AND LABORATORIES

617 West Lake Street Chicago 6, Ill.

Offices in Principal Cities

How to insulate exposed boiler drum heads



Boiler drumheads that require insulation are often shipped to the job with a metal rim welded around manhole, and metal lugs on drum body (1). Sometimes, the lugs and rim are omitted (2). In each case, how should insulation be applied?

HERE'S HOW THE ARMSTRONG FOREMAN DOES IT:

In case No. 1, when lugs and rim around manhole both are provided, holes are first drilled in the rim. Then a ⅛" cable can be stretched around the drum, through the lugs. Insulation is laced on with wire stretched from the cable to the metal rim around the manhole. If the lugs are close enough together, the cable can be omitted and the wires attached to the lugs.

In case No. 2, there are no lugs or other means of holding the wire on the drum surface. Then a ⅛" cable can be drawn up tightly around the drum. Another length of cable is used around the manhole, and insulation is held on the drum and drumhead by wires drawn tightly between these two cables.

In many cases, insulation cannot be secured to drumheads by either of the methods outlined here. Then it is up to the insulation construction foreman to call upon his previous experience or to improvise the best possible method for the job at hand. How well the foreman is able to do this is one indication of the ability of an entire contracting organization. If these key men have plenty of experience and are part of a smooth working team, you get your work done fast and well. We're especially proud of the ability of our construction foremen and crews. They are an important part of Armstrong's Complete Insulation Contract Service, which includes good materials and expert engineering advice, in addition to competent workmen.

FREE BOOKLET

Write today for your free copy of the 28-page booklet, "Armstrong's Industrial Insulations." Armstrong Cork Company, Industrial Insulation Dept., 7005 Maple Ave., Lancaster, Penna.

ARMSTRONG'S INDUSTRIAL INSULATION

Complete Contract Service
For All Temperatures

From 300° Below Zero

To 2800° Fahrenheit

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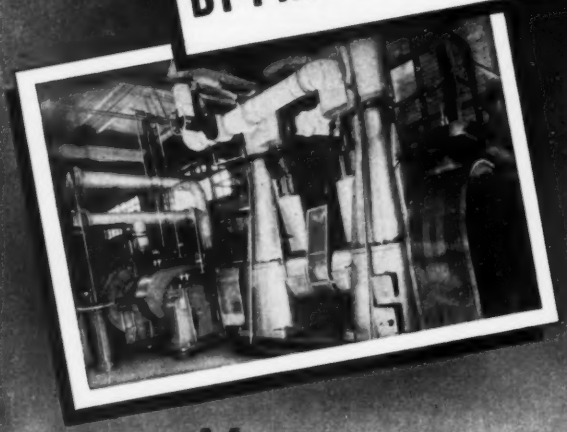
STEAM ENGINE

SAVE
BY USING
BY-PRODUCT POWER



Make your STEAM do two big jobs . . . eventually one of them at little or no cost. With proper heat balance your steam can provide—FIRST, power for driving equipment, and SECOND, heat units needed for processing or heating.

Use boiler steam to run a Troy-Engberg Steam Engine. THEN use the exhaust in your heating or processing lines. Drive your pumps, stokers, generators, blowers or compressors with By-Product Power. Use a Troy-Engberg Steam Engine as a reducing valve and your power cost saving will pay for the engine in a very short time.

Send for Bulletin 306

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TROY-ENGBERG
STEAM ENGINES • GENERATING SETS • GENERATORS

Honeywell Acquires Vaive Company Assets

Minneapolis-Honeywell Regulator Co announced that it has entered an agreement for acquisition of the assets of H Belfield Co, manufacturers of control valves. Harold W Sweatt, Honeywell president, said that Howard L Murray, president of Belfield, would be elected vice-president of Minneapolis-Honeywell and would be in charge of the new acquisition, which will be known as Belfield Valve Division of Minneapolis-Honeywell.

Products of the division, including certain types of automatic control valves not previously made by Honeywell, will be distributed nationally through branch offices in this country and abroad through foreign subsidiaries. In addition, the new acquisition will enable Honeywell to supply its own control valves for application with industrial controlling instruments of the type made by the company and its Brown Instruments Division. Valves made by Belfield will also be applied to automatic control systems made by Honeywell for use in heating and air-conditioning installations.

All personnel of Belfield will continue with the company in the same capacities.

Record Attendance at ACI Fuel Conference

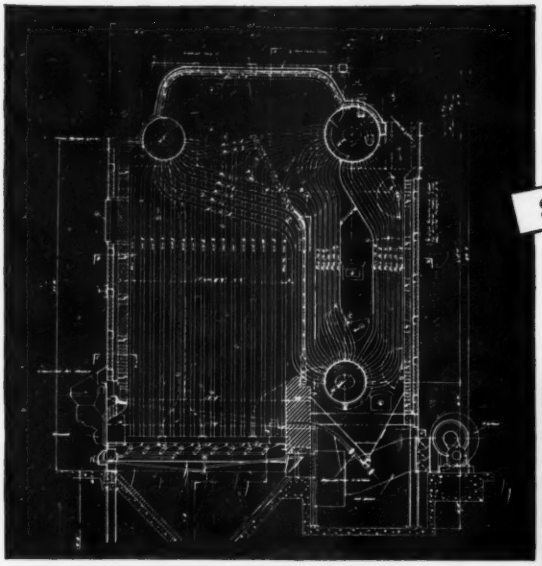
The 27th Appalachian Coals Inc Fuel Engineering Conference, co-sponsored by the Detroit Section, ASME, was attended by the largest group ever to be present at one of these meetings.

Nearly 1000 fuel engineers, industrial executives, equipment manufacturers, consulting engineers and representatives of educational and research institutions heard James D Francis, president of Island Creek Coal Co, Huntington, W. Va. speak of the present and future of coal. Citing the large investment needed in new machinery to continue the industry on a sound basis, he emphasized the great potentialities of further mechanization of mining, handling and cleaning operations. If it is to keep itself in a position to meet requirements, the coal industry must have a fair and reasonable profit and buyers of coal must understand that it is to their advantage to be able to secure their coal from a responsible source. "While price is important, fuel is essential," he said.

Speaking on "Standardized Design of Industrial Boiler Units," Donald S Walker, vice-president, Combustion Engineering-Superheater, Inc, emphasized the many benefits derived from installations of standard design. By taking the "whim" out of boiler design on the part of purchaser, consulting engineer and manufacturer, construction and delivery can be speeded and costs cut, he said.

Setting forth some of the reasons for growth in application of spreader stokers, William S Major, development engineer for Bituminous Coal Research, litsed these factors for maximum operating efficiency and satisfaction in spreader installations: (1) furnaces that will burn smaller as well as special sizes of coal (2) reinjection of cinders from last-pass hoppers and flyash

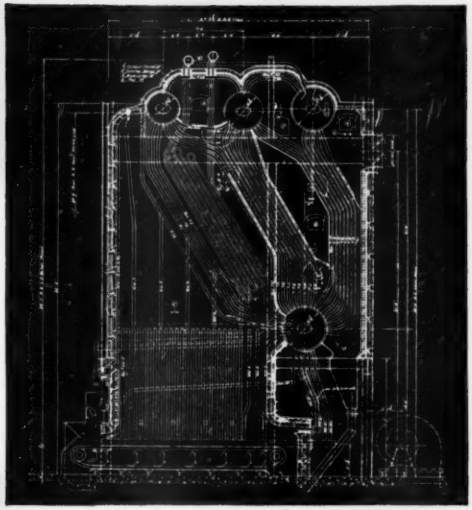
Quick Steaming at all Ratings!



Carry high overloads with high efficiency

SPECIFY **Vogt**

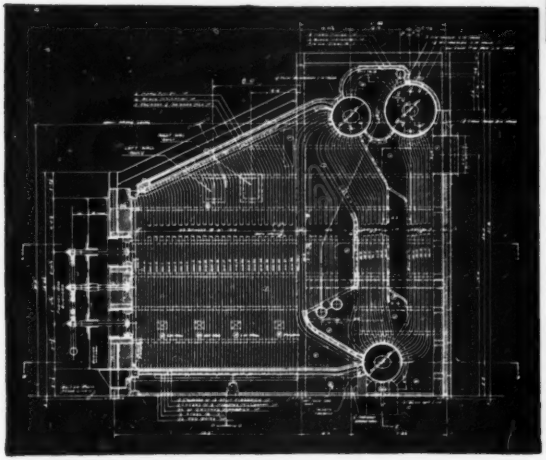
STEAM GENERATING UNITS



CLASS VL Two 27,500 pounds per hour units, installed at Brown-Forman Distillers Corporation, Louisville, Ky. Features large furnace volume in limited space, with high ratio of radiant heating surface.

CLASS LE Mt. Carmel Public Utility, Mt. Carmel, Illinois, is served by this 60,000 pounds per hour unit. Generous steam liberating surfaces and steam space permit wide fluctuations in load.

CLASS VR 70,000 pounds per hour steam generator at Humble Oil and Refining Company, Johnsue, Texas. An efficient, high-duty unit with water cooled furnace, using refinery gas fuel.



Vogt builds a complete line of bent tube steam generators, designed to burn solid, liquid, or gaseous fuels to meet specific operating conditions. Superheaters, air preheaters, economizers, water walls, and soot blowers can be readily incorporated. Bulletins with general information and showing typical installations are available upon request.

HENRY VOGT MACHINE CO.

LOUISVILLE 10, KENTUCKY

BRANCH OFFICES:
NEW YORK, PHILADELPHIA, CLEVELAND
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New... a cost-saving

EXCHANGE PLAN

for TRI/CLAD *Integral-hp Motors*

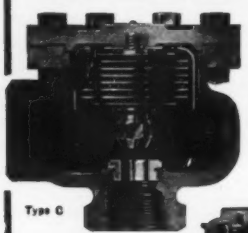
LOOK for this EXTRA on the motors you buy

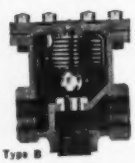
General Electric is happy to announce that the motor exchange plan which proved so successful with fractional-hp motors has been extended to cover integral-hp Tri-Clad motors. 16 Motor Exchange Centers are prepared to make an immediate exchange of Tri-Clad open (dripproof) motors (popular types, 4-pole, 1 to 5 hp) during the first five years of service. How the new plan works to reduce machine down time and motor replacement costs is told in Bulletin GEA-5189 (for motor users) and Bulletin GEA-5180 (for machinery manufacturers). SEND FOR YOUR FREE COPY to *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

756-2

GENERAL ELECTRIC

Nicholson Steam Traps SPEED CIRCULATION





7 Reasons Why:

1. BIG DISCHARGE, 2 to 6 times average traps.
2. NO AIR-BINDING. Discharge both air and water.
3. NO FREEZE-UPS. Drain completely when cold.
4. NO DRIBBLING. Close tight when steam is in trap.
5. NO ADJUSTMENT needed for varying pressures.
6. NO WATER-LOGGING. Operate on lowest temperature differential, 5° to 15°, depending on trap size and steam pressure.
7. LOWEST STEAM WASTE. As little as 1%.

5 TYPES for every industrial application. Sizes 1/4" to 2"; press. to 225 lbs. BULLETIN 1047.

Control Valves for All Mediums

For steam, water, air, gas, oil; and for all types of operation—lever, foot, solenoid, motor. Choice of 6 metal combinations to meet specific needs. Pressures to 5000 lbs. CATALOG 546.

W. H. NICHOLSON & CO., 125 Oregon St., Wilkes-Barre, Pa.

collectors, and (3) efficient dust collectors to assure a clean atmosphere regardless of type of fuel burned.

Principal speaker at the evening session, Walker L Cisler, executive vice-president of Detroit Edison Co, stated that private utility systems will make an average annual investment of $1,500,000,000 in power-expansion programs in the next five years. Referring to the close association between the coal industry and the electric-utility industry, in whose operations solid fuels have been the major source of energy supply, he cited gains made in fuel utilizations—in 1914 a ton of coal produced 525 kwhr, in 1946, 1550 kwhr, and modern steam plants of today and tomorrow will individually attain a production of 2400 kwhr per ton of coal. He predicted that, in the foreseeable future, coal will be used in about two-thirds of new fuel-burning capacity. In conclusion Mr Cisler pointed out that there is an immediate need for additional electric power all over the world in order that living standards of other countries can be built up.

Julian E Tobey, president of Appalachian Coals, Inc, was conference chairman.

Grand Coulee Chalks Up New Kwhr-Output Record

What is probably a world's record for any plant was chalked up at Grand Coulee on the Columbia River in Washington during the month of January, when the nine main units generated 838,278,000 kwhr for the month. On Jan 29 a daily record of 27,397,000 kwhr was set.

The waterwheels were designed for 150,000 hp each and the generators for 108,000 kw at unity power factor. Availability of excess capacity is indicated by the fact that average load for the month was 123,700 kw on each machine, while on Jan 29 it was 127,000 kw. On that day each waterwheel delivered an average of 180,000 hp to its generator, assuming a generator and bus efficiency of 95% to the point of output measurement.

Announce Merger of Two France Companies

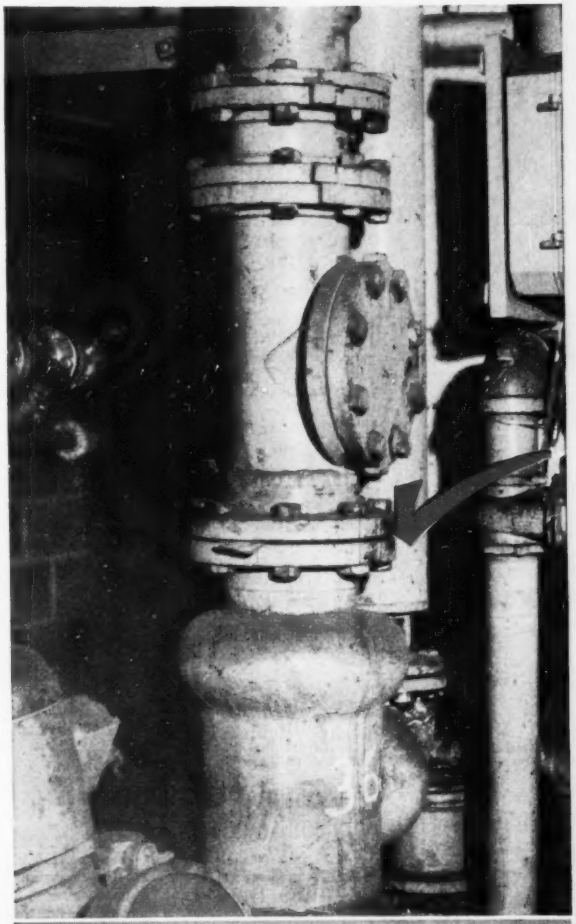
The France Packing Co and the France Manufacturing Co, both of Philadelphia, have been merged into the France Packing Co. Main plant and offices of the newly merged company will be at the former address, 6512 State Rd, Philadelphia 35, Pa. Both plants will continue in operation under the new management, according to E A France, president of the new company.

Long identified as pioneers in manufacture and development of metal packing, the two companies have followed somewhat parallel careers. The France Packing Co (parent company) was founded in 1897 by A W France, while the France Manufacturing Co was formed in 1927 by his son, E A France.

The company has sales representation in all principal cities of the U. S. and Canada, and plans to expand sales activities in accordance with its improved facilities for service and manufacturing.

To The Chemical Industry:

PLAY SAFE with



BS&B SAFETY HEADS

Black, Sivalls & Bryson SAFETY HEADS offer the chemical industry unfailing protection against *over*-pressure "bursting point" danger. To our knowledge, *no vessel protected by a SAFETY HEAD has ever blown up!*

The BS&B SAFETY HEAD is a simple, easily installed metal rupture disc, held between specially designed base and hold-down flanges. It positively bursts at predetermined pressure. More than 100,000 of these discs have been burst in the BS&B laboratories to assure absolute precision in *over*-pressure control.

Don't let another day go by without seeing to this basic protection for life and property!

Write or call Special Products Division, Dept. SH- 6. Black, Sivalls & Bryson, Inc., Power and Light Bldg., Kansas City 6, Mo.

BS&B SAFETY HEADS

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I'd like full details of the BS&B Safety Heads.

☐ Please forward complete data.
☐ Arrange to have Sales Engineer call on me.

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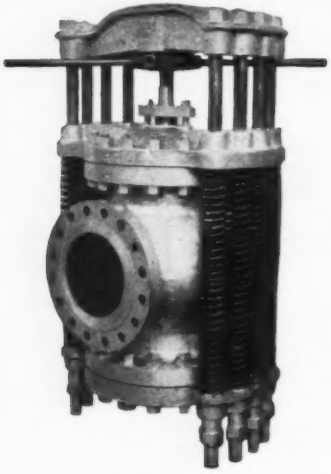
A VALUE THAT WILL INTEREST EVERY POWER ENGINEER



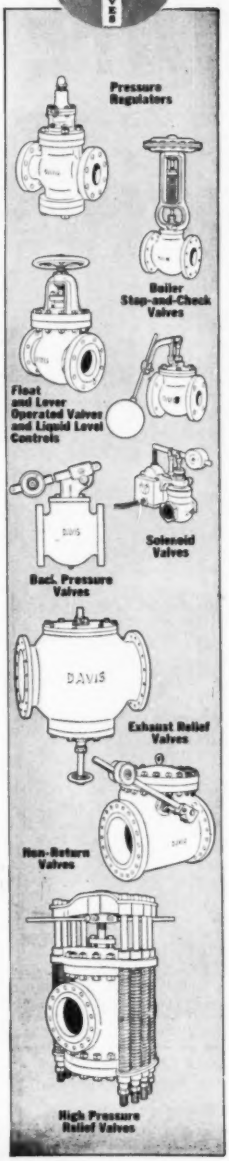
The DAVIS No. 265 HIGH PRESSURE RELIEF VALVE

USES.—(1) For turbine relief on bleeder system. (2) For protection of any boiler room or process equipment by relief to atmosphere. (3) For relief of high pressure lines to low pressure lines at predetermined pressure. (4) For use in plants carrying multiple boiler pressures to protect lower pressure systems.

ADVANTAGES.—Multiple springs result in less spring accumulation . . . less build-up for maximum relief . . . less blowdown to close. Compact design with springs at sides reduces headroom requirements. Center adjusting screw available for quick, easy change of pressure setting.

BUILT TO REQUIREMENTS. Offered in sizes from 4" to 30" in semi-steel or steel with bronze or stainless steel trim. Test lever and hold-open device available when desired. Detailed information on request.

DAVIS VALVES



DAVIS REGULATOR CO.

Representatives in All Principal Cities

2540 S. WASHTENAW AVE., CHICAGO 8, ILL.

Cochrane Acquires Liquid Conditioning

Cochrane Corp, Philadelphia, manufacturers of water-conditioning equipment and steam specialties, announces acquisition of Liquid Conditioning Corp, of Linden, N. J. The newly acquired company manufactures conditioning equipment for water and other liquids under the trade name *Liquon*. It will operate as a wholly owned subsidiary, continuing to market its products under the name *Liquon*.

According to T E McBride, president of Cochrane, the engineering, sales and technical staffs of the two companies will augment each other. S B Applebaum, one of the organizers and an officer of Liquid Conditioning Corp, will be in charge of cold water conditioning activities of both organizations, as well as conditioning of liquids other than water. Liquon district sales offices are combining operations with existing Cochrane sales offices.

Tube Expander Business Purchased by Wilson

Purchase of the tube expander business of Richard Dudgeon Inc, New York, N. Y., by Thomas C Wilson Inc, Long Island City, N. Y., was recently revealed in a joint announcement by O J Bagnoli, Wilson vice-president, and Archibald Dudgeon, president of Richard Dudgeon.

Wilson, long-established maker of tube-cleaning equipment, acquires Dudgeon's complete tube-expander business including inventory, engineering data, goodwill and sole manufacturing rights. The purchase thus expands Wilson's line to handle both rolling and cleaning of all types of tubing in heat-transfer equipment ranging from the smallest lube-oil heaters through central-station boilers.

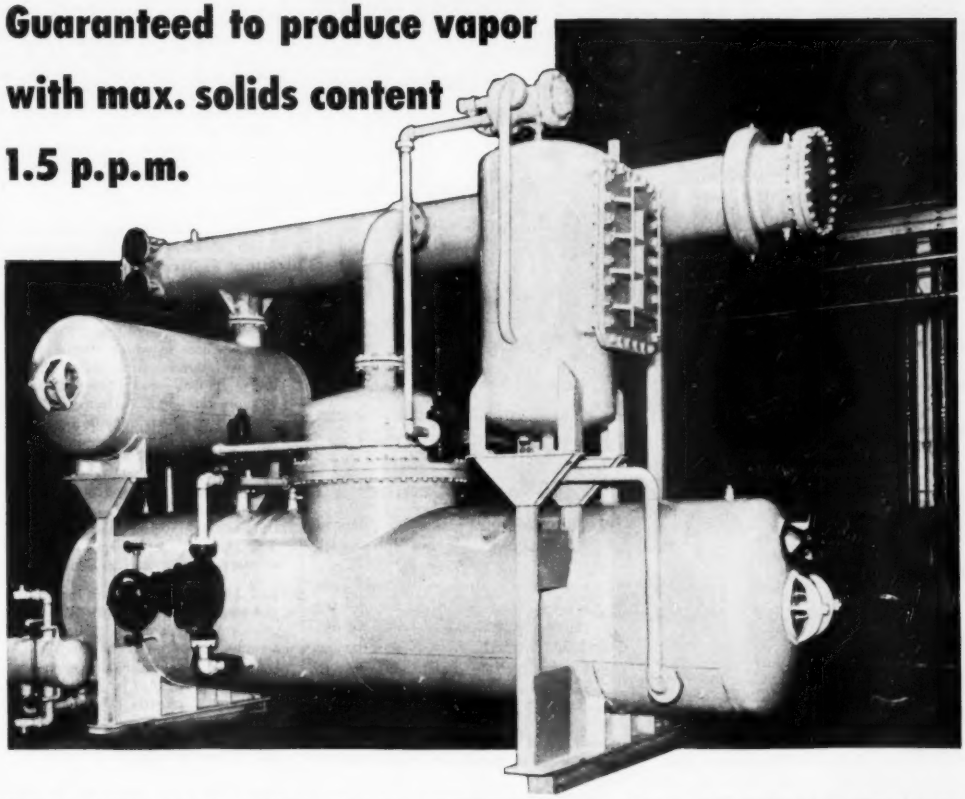
Manufacture of Wilson tube cleaners and Wilson-Dudgeon tube expanders will be combined in the Thomas C Wilson Inc plant at 21-11 44th Ave, Long Island City. In the future, Richard Dudgeon Inc will devote its entire efforts to production of hydraulic machinery.

Oakite Products Has 40th Anniversary

In a special anniversary issue of *Oakite News Service*, 33-year-old house magazine, Oakite Products, Inc commemorates 40 years of activity in the field of specialized cleaning materials and methods. With a brief look at the past, the special issue devotes most attention to the scope of the company's present services, a summary of its organization, the training of its representatives and examples of uses of its services in many industries.

At the winter meeting of the National Electrical Manufacturers Association in Chicago, Richard T Stafford, assistant to the executive vice-president, Allis-Chalmers Mfg Co, was awarded the association's 50-Year Certificate.

Guaranteed to produce vapor with max. solids content 1.5 p.p.m.



LUMMUS UNIT ALSO SAVES SPACE, FOUNDATIONS, AND STRUCTURAL SUPPORTS

In designing and building this package unit for the Rockland Light and Power Company's Hudson plant, Lummus kept it within space limitations by mounting the deaerating feed preheater, the evaporator condenser, the condensate receiver, and the control equipments all on common supports with the evaporator.

The effective tube surface is 478 sq. ft.

The unit is guaranteed to produce vapor with a solids content of not more than 1.5 p.p.m when the total solids in the shell liquid is maintained at 3,000 p.p.m. This vapor purity is assured by Lummus' steam scrubber, which can produce purity of 1 p.p.m.

For heat exchanger equipment of any type, be sure of complete satisfaction—make sure the job goes to Lummus.

THE LUMMUS COMPANY
Heat Exchanger Division
250 West 14th Street, New York 11, N. Y.

LUMMUS

Atlanta • Boston • Chicago • Cleveland • Corpus Christi
Detroit • Houston • Fort Worth • Philadelphia • Pittsburgh
Minneapolis • Rochester • St. Louis • San Francisco
Buenos Aires • Honolulu • Manila • San Juan, P. R.

LOOK TO LUMMUS for Heat Exchangers • Process Condensers • Reboilers • Steam Generators • Steam Jet Refrigeration Steam Surface Condensers • Barometric Condensers • Steam Jet Air Ejectors • Evaporators • Boiler Blowdown Heat Exchangers Fuel Oil Heaters • Lubricating Oil Coolers • Pipe Line Coolers • Feed Water Heaters • Jacket Water Coolers

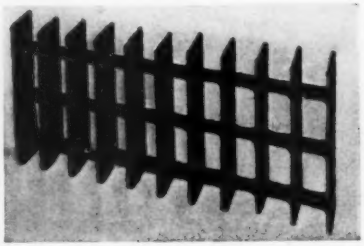
Under Extreme Conditions

of atmospheric corrosion

for Twelve Years

Here's a section from a panel of Hendrick Mitco that for twelve years was exposed to atmospheric corrosion in an open yard of an industrial plant. It was actually under water much of the time.

Note that the joints show the least corrosion and have no crevices or cracks, although the side surfaces of the bars have been partially eaten away.



90% is open area

Pressure-formed under hundreds of tons of hydraulic pressure, Hendrick Mitco Open Steel Flooring has rectangular openings with 90% open area which offers minimum obstruction to the passage of light and air. The uniformly spaced, square-edge bars provide a level, non-slipping walking and trucking surface.

Widths up to 38"; lengths to suit span. Standard Type C Flooring has bearing bars either $\frac{3}{16}$" or $\frac{1}{8}$" thick, spaced on $1\frac{3}{16}$" centers; transverse bars are spaced on 4" centers. Closer or wider spacings can be furnished to meet special requirements.

Plus a special safety feature

Shur-Site Treads for stairs, ladders and fire escapes are integral units of Hendrick Mitco Open Steel Flooring and have all Mitco advantages. For accident prevention, a heavy flanged nosing bar under the front edge of each tread makes the edge clearly visible; it also provides additional strength where the load is greatest.

Never require rebuilding

For floors, platforms, ramps and driveways, Hendrick Mitco Armorgrids withstand heavy loading and the hardest traffic. No structure armored by Hendrick Armorgrids has ever required rebuilding. The panels may be used with fill of concrete, cement, asphalt, or composition material, with the tops of the panels flush with the surface. Armorgrids are easy to install, because they are shipped completely fabricated and require no assembly work in the field.

Write for Hendrick Mitco Products Catalogue

SEE OUR CATALOG IN SWEET'S

HENDRICK

Manufacturing Company

46 DUNDAFF STREET, CARBONDALE, PENNA.

Sales Offices In Principal Cities

Perforated Metals
Perforated Metal Screens
Architectural Grilles
Mitco Open Steel Flooring,
"Shur-Site" Treads and
Armorgrids

APPOINTMENTS

American District Steam Co, North Tonawanda, N. Y., names Lyman D Warner vice-president to assist Samuel J Childs, executive vice-president and general manager. Also Glenn D Culbert, 1006 DuPont Circle Bldg, Washington, D. C., is a sales representative for the firm. Territory includes District of Columbia, bordering counties of Maryland, and northern portion of Virginia.

Alfred S. Gartner has joined sales organization of **Cornell-Dubilier Electric Corp,** South Plainfield, N. J., as assistant to Arthur Williams, sales manager of capacitor manufacturing div.

Bailey Meter Co, Cleveland, Ohio, expands its staff of field engineers. The men, with branch offices to which they are assigned, are as follows: R E Byers—St. Louis; N P Campbell—San Francisco; G F Fitzpatrick—Denver; R A Homan—Pittsburgh; T A Melton—Charlotte; W G Thiemann—New York; J F Kontz—Cleveland; G H West—Atlanta; N S Wilson—Philadelphia; M G Johnson—Houston; R P Marchc—Chicago. R E Ellis and W H Robbins are assigned to the engineering dept; R E Hartman and R E Paulson to sales dept; A L Wade to patent dept; and F S Holby to research dept in Cleveland.

Earl M Converse has been eelcted senior vice-president and Eugene P Fager vice-president and industrial dept manager of **Dearborn Chemical Co,** Chicago. Arthur L Johnson has been named secretary-treasurer and a member of the board of directors. In Toronto, Canada, Dearborn Chemical Co, Ltd, has announced election of H Neville Potter as executive vice-president and general manager.

Link-Belt Co's warehouse and district sales office in Spokane, Wash., is now located at North 1303 Washington St. At the firm's Philadelphia plant, J H Oakes becomes sales manager, enclosed drives. Harry F Kurz will assist Oakes as representative, enclosed drives, with headquarters at the Pershing Rd plant in Chicago. Carl A Woerwag, retiring because of ill health, is succeeded by Roy E Jones as export manager in New York City.

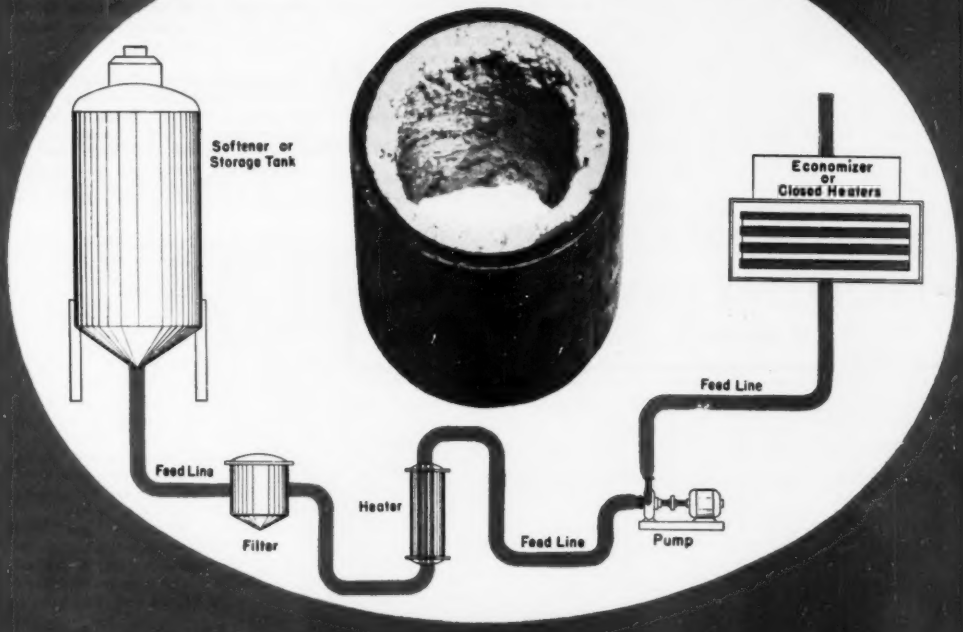
Marvin Wall is sales engineer in the Southwest for heavy machinery div, **Nordberg Mfg Co,** Milwaukee. Wall's territory includes Texas, New Mexico and Oklahoma with headquarters at 419 Cotton Exchange Bldg, Dallas, Texas.

Hagan Corp names Alfred Watson to replace Charles A Randorf as manager of its Buffalo district office.

Resignation of Melvin C Harris as vice-president, in charge of production, has been announced by **Allegheny Ludlum Steel Corp.** Pending election of a successor, C B Pollock, production manager, will be in charge of production for the company.

Several personnel changes have been made in **Black, Sivalls & Bryson Inc,** as follows: Floyd C Myers, regional sales manager, has transferred his headquarters to 2006 West Indiana, Midland, Texas. John

PREVENT DEPOSITS IN THE FEEDWATER SYSTEM WITH DREW *Organic* STABILIZERS



Objectionable deposits may occur in the feedwater system because of the adherence of materials that precipitate from the water. The principal causes of precipitation are the effect of heat on hardness and iron, and the effect of boiler water treating chemicals (alkalies and phosphates) on hardness.

Drew Organic Stabilizers prevent deposits in feedlines, economizers, heaters, and other portions of the feedwater system.

Your local Drew engineer is available to discuss all aspects of water treatment and related problems.

POWER DREW CHEMICALS

E. F. DREW & CO. INC.
15 E. 26th ST., NEW YORK 10, N. Y.
Representatives in all key cities

BOILER WATER TREATMENT
COOLING WATER CONDITIONING

ALLPAX

. . . the PACKING that packs ALL

ALLPAX is the *universal* packing for general service . . . for all stuffing boxes of any size or shape . . . for steam, water, air ammonia, oils, gases, distillates, etc., where temperature does not exceed 600F.

With ALLPAX there is no necessity to keep on hand a special packing for this or that use. you can standardize on ALLPAX for *all general purpose uses* and be assured of long-lived, economical service wherever it is used.

ALLPAX is a combination of long, tough fibres of asbestos, thin flakes of highest grade anti-friction metal, minute flakes of graphite, and a special non-liquid heat-proof lubricant, compounded to assure long-wearing, leak-proof, non-scoring packing for severe service. Its low friction cuts down power losses and improves efficiency.

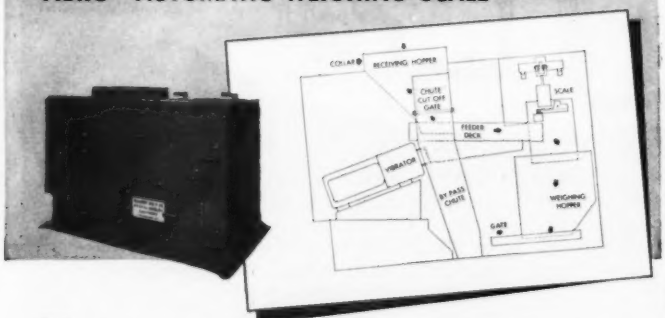
Special styles available for special service.

Try ALLPAX once and you'll use it always. Distributors everywhere.

THE ALLPAX COMPANY, INC.

Mamaroneck, New York

No Troublesome Belts . . . IN THE BEAUMONT "VIBRO" AUTOMATIC WEIGHING SCALE



WHY bother with belts, pulleys and motors in weighing scales?

The stainless steel vibrating feeder in the Beaumont "Vibro" Automatic Weighing Scale has no belts or moving parts—eliminates faults. It is particularly well adapted to very abrasive materials and the rate of feed can be easily adjusted by a rheostat controlling the vibration of the feeder.

Other features include: high weighing accuracy, feeder capacity from 1 to 60 tons per hour, dust proof construction, quiet operation and long life. We can promise prompt shipment on standard units. Write for descriptive bulletin.

BEAUMONT BIRCH Company
1502 RACE STREET—PHILADELPHIA 2, PA.

Designers Manufacturers Erecters BULK MATERIAL HANDLING SYSTEM

T Cross Jr has been appointed branch manager at Hobbs, New Mexico. C W Hayes, engineer, has taken temporary charge of the company's sales office in New Orleans, La. Benjamin W Bourne, sales engineer, has been transferred to Midland, Texas sales office. James R Banks, sales engineer, has joined the firm and will be stationed at New Orleans. Also, a sales office has been opened in Magnolia, Ark., under direction of Raymond D Canada.

Taylor Instrument Companies assigns A M Wallace to Portland, Ore., and R M Garrett to Los Angeles, Calif., as salesmen for the organization.

Brooks Rotameter Co names John G Kirkpatrick as its representative in the Pittsburgh area, including western Pennsylvania and West Virginia.

Frank A Depatie becomes manager of newly established service dept of **Parker Appliance Co,** Cleveland. Functions brought together under this dept are customer service on delivered materials, spare parts recommendations, functioning and overhaul data, and supervision of operation and parts manuals.

General Electric Co announces following appointments in its construction materials dept: In accessory equip div, Richard A Brown is named supervisor of commercial scheduling, responsible for control and scheduling of finished stocks of accessory equipment going direct to customers or into warehouses. William W Marden becomes supervisor of order service. Fay C Ralph is now commercial engineer for the div, with duties assigned by the manager. In wire and cable div, Lyde E Howard is made sales manager, electric utility sales, with headquarters in Schenectady, N. Y. James F Farnam is sales manager, industrial and contractor sales, with headquarters at Bridgeport, Conn. W J Delehanty becomes sales manager, Oakland section of wire and cable div, in Oakland, Calif. Walter S Hay manages transportation, federal, state and municipal sales in Bridgeport.

GE has also made the following appointments in its construction materials dept, wire and cable div: John J Curtin has been assigned to Schenectady, N. Y., as manager, magnet wire sales. G Bryan Shanklin has been made manager of commercial engineering for electric utilities at Bridgeport. Reginald B McKinley has been promoted to manager of commercial engineering, industrial and transportation, with headquarters in Bridgeport. In addition, S W Corbin has become assistant manager, industrial divisions of apparatus dept in Schenectady. Corbin also retains his position as manager of resale industries div.

A King McCord has been elected to the board of directors, **American-Marietta Co,** Chicago. Other directors who previously served have been re-elected.

Carborundum Co announces following changes in its district sales office personnel: H P Erbe succeeds F H Appenrodt, who resigned, as office manager of Pittsburgh district sales office. R L Heimstadt is pro-

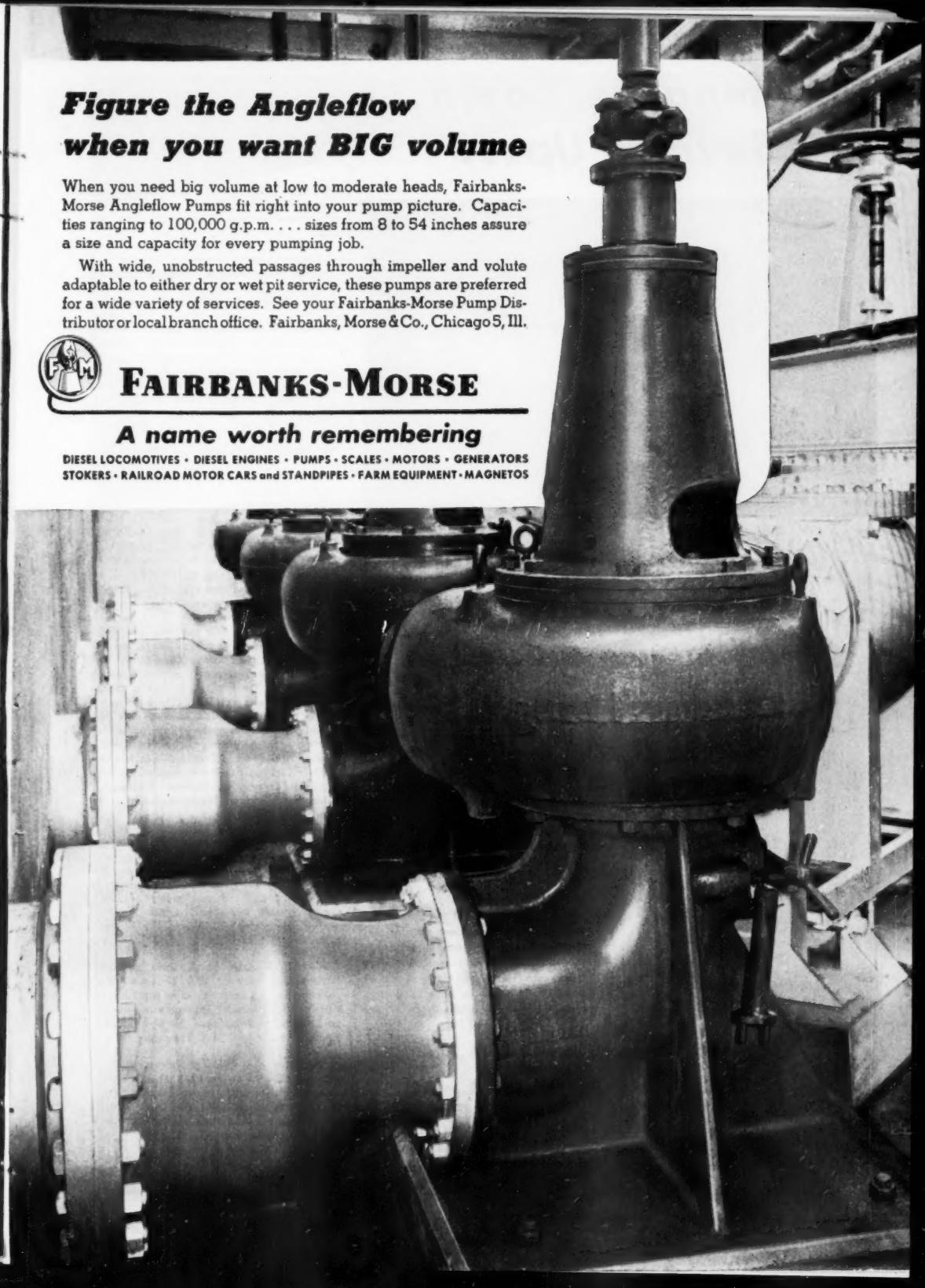


Figure the Angleflow when you want BIG volume

When you need big volume at low to moderate heads, Fairbanks-Morse Angleflow Pumps fit right into your pump picture. Capacities ranging to 100,000 g.p.m. . . . sizes from 8 to 54 inches assure a size and capacity for every pumping job.

With wide, unobstructed passages through impeller and volute adaptable to either dry or wet pit service, these pumps are preferred for a wide variety of services. See your Fairbanks-Morse Pump Distributor or local branch office. Fairbanks, Morse & Co., Chicago 5, Ill.

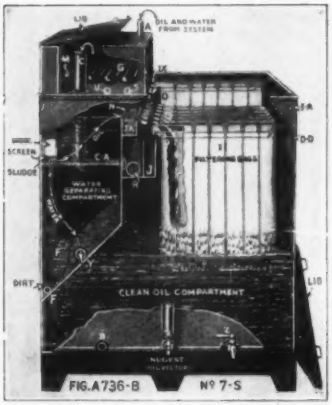
FAIRBANKS-MORSE

A name worth remembering

DIESEL LOCOMOTIVES • DIESEL ENGINES • PUMPS • SCALES • MOTORS • GENERATORS
STOKERS • RAILROAD MOTOR CARS and STANDPIPES • FARM EQUIPMENT • MAGNETOS

Maintenance Down... Savings Up...

When you use NUGENT GRAVITY OIL FILTERS for turbine systems



Nugent Gravity Oil Filters are the economical method of handling filtering problems in large stationary installations. Experience shows that average oil savings are in excess of 95%. And by assuring a continuous supply of CLEAN oil, maintenance is reduced and equipment life extended substantially. For protection against corrosion Nugent Filters neutralize acidity and maintain a safe value. For economy's sake you can't afford to be without a Nugent Oil Filter.

Nugent Gravity Oil Filters may be operated continuously since each of the multiple filtering units can be removed independently for cleaning. And for further convenience an alarm is given automatically when cleaning is necessary. Write for full details today.

NUGENT TRADE MARK

Wm. W. Nugent & Co., Inc.

402 N. Hermitage Ave. CHICAGO 22, ILLINOIS

OIL FILTERS, OILING AND FILTERING SYSTEMS, TELESCOPIC OILERS, OILING DEVICES, SIGHT FEED VALVES, FLOW INDICATORS

Established 1897

Representatives in Boston • Cincinnati • Detroit • Houston • La Junta, Colo. • Los Angeles Minneapolis • New Orleans • New York • Philadelphia • Portland, Ore. • San Francisco Seattle • St. Louis • Tulsa • Representatives in Canada: Montreal • Toronto • Vancouver

moted to office manager of Cleveland district office sales, replacing Erbe. D S Masson, now assistant to district sales manager in Detroit, is responsible for over-all operation of the office under J F Claydon. J R Middleton continues as office manager in Detroit.

Republic Flow Meters Co, Chicago, appoints Kenneth K Kenzel manager of its Cincinnati district office at 3197 Linwood Ave.

E Corbin Chapman becomes chief metallurgist of **Combustion Engineering-Superheater Inc.** He will remain at the company's plant in Chattanooga, Tenn.

Quaker Rubber Corp names John R Lewis manager officially-in-charge of district No. 2 of its sales organization. Territory under Lewis' supervision includes Pennsylvania, Maryland, Delaware, Virginia, Tennessee, North and South Carolina, Georgia, Florida and Alabama.

Wilson W Wheeler is now sales manager for **Askania Regulator Co,** Chicago, Ill.

W B Osgood has been made a partner in Dunbar Engrg Co, New York City, representing **Edward Valves Inc.**

Appointments in the sales organization of **Binks Mfg Co** are as follows: H J Fink directs sales and service in Colorado, Kansas, Nebraska, Wyoming, Montana and New Mexico from headquarters at Longmont, Colo. C J Rood, as manager of Indianapolis branch office, directs sales and service in Indiana. M B Scully handles northern Illinois and Iowa State from headquarters at Princeton, Ill., and E J Cremer in St. Louis, takes care of southern Illinois and state of Missouri. B R Fulton is in charge of Binks new direct factory sales and service branch at 1231 W Ninth St, Cleveland, handling the Ohio territory. Harvey J Dueno manages the firm's Milwaukee branch office from new quarters at 1123 N Jackson St. He is responsible for sales and service throughout Wisconsin, peninsular Michigan, Minnesota, and North and South Dakota.

J J Lynch, for many years a sales engineer with Binks Mfg Co, has organized the **Bay State Spray Equip Co.** He will be in charge of all sales and service throughout entire New England and greater Boston area. Lynch's new quarters are at 175 Walnut St, Springfield, Mass. The Boston location is 116 Bedford St.

Kieley & Mueller Inc, names Richard Barthlemess Sales Co, 105 W Adams St, Jacksonville, its exclusive sales representative in Florida. Sales engineers in charge are Richard Barthlemess, H A Fleming, Frank Moriarty and M C Thompson.

C H Benbrook becomes director of research and development of **Ozalid** div, General Aniline & Film Corp, Johnson City, N. Y. In this capacity he also assumes full responsibility for quality control of the division's products.

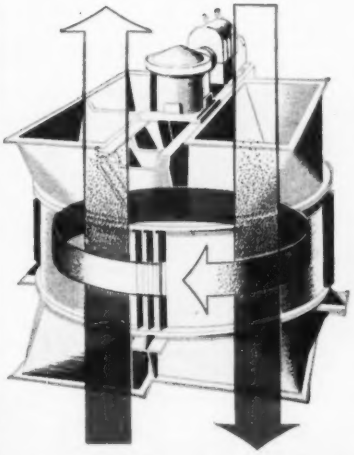
Establishment of a shop with complete production facilities for manufacture of heat-transfer equipment has been made by

Fact File on Preheat

No. 2

In the Ljungstrom Air Preheater, air and flue gases are each uniformly distributed as they flow through the heating surface. This uniform flow through the rotating heating element maintains nearly constant temperatures at any given cross-section. "Cold spots," which often initiate plugging, do not exist at any part of the heat exchange surface.

LJUNGSTROM



The Ljungstrom Air Preheater is a compact gas-to-air or gas-to-gas heat exchanger, operating on a continuous regenerative counterflow basis. Hundreds of power plants and other special applications confirm its high level of heat recovery and long-term service at low maintenance expense.

THE

AIR PREHEATER CORPORATION

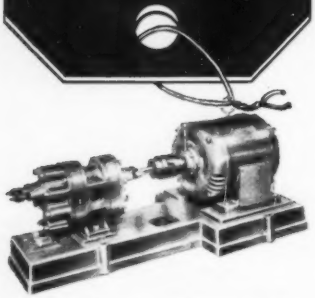
60 EAST 42ND STREET · NEW YORK 17, N. Y.

Plant: Wellsville, N. Y.

960

MAINTENANCE CREW HANDS OFF!

--it's a SIER-BATH ROTARY PUMP



Sier-Bath Screw Pumps and Gearex Pumps are designed to do a job—and keep doing it. The manufacturer has a full appreciation of the high cost of interrupting the operation of a line to permit pump repairs. On the Internal Gear-type Screw Pump, for example, the gland is the only point of attention and as this is on the suction side, it is almost negligible. It is not unusual for the packing to last two years without repacking. The pressure on the gland is so slight that it is possible to add a new ring of packing without shutting down the unit. Send for information.

ALSO MAKERS OF SIER-BATH PRECISION GEARS

FOUNDED 1905 MEMBER A.G.M.A.

Sier-Bath GEAR and PUMP CO., Inc.

9254 HUDSON BLVD NORTH BERGEN, N J

Vessel div of **A O Smith Corp.** P A Thompson has joined the division as product supervisor of heat-transfer equipment.

T H Banfield, president of Iron Fireman Mfg Co, Portland, Ore., has been elected a member of the board of directors of **Stanford Research Institute.**

Clifford M Lewis assumes duties of sales promotion manager of **Canton Stoker Corp,** Canton, Ohio.

L O Koven & Brother Inc, Jersey City, N. J., announces appointment of H W MacIntosh as treasurer of the company.

New manager of instrument div, **Thomas A Edison Inc,** West Orange, N. J., is Arthur A Blue.

Farrel-Birmingham Co has chosen M H Blank its representative in Detroit area to handle sales of the firm's line of gears and gear units. Blank's offices are at 901 Lafayette Bldg, Detroit 26, Mich.

Mine Safety Appliances Co, Pittsburgh, Pa., adds Mac L Crews to its industrial sales field force.

Slaybaugh-Thompson Co, Denver, Colo., represents **General Switch Corp** in Colorado, Utah and Wyoming. The company will service electrical wholesalers in the above territory and furnish technical assistance to architects, engineers and contractors in connection with the specification of General Switch equipment.

George N Decker becomes comptroller of **Kellogg** div, American Brake Shoe Co. He will continue to be located in Rochester, N. Y.

Livingstone Engrg Co, Worcester, Mass., has elected Bradley C Higgins vice-president and purchasing agent.

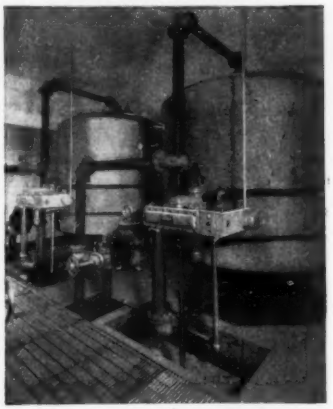
Boiler Equip Trust, Amherst, Mass., has acquired Valve Maintenance Co, Orange, Mass., formerly a division of Boiler Equip Trust, and Barr Constructors of Norristown, Pa. They manufacture soot blowers of fixed nozzle type for all types of firetube boilers. Equipment of Barr Constructors will be moved to Orange and most of the manufacturing and valve-repair work will be done there. In both cases, personnel of each will continue with Boiler Equip Trust.

T Kennedy Stevenson retired as vice-president and director of Western Electric Co and is now chairman of the executive committee of **Griscom-Russell Co.** He is located at 285 Madison Ave, New York City, headquarters of Griscom-Russell.

Ralph G Harmon is now district manager of **Timken Roller Bearing Co's** industrial and steel and tube divisions in Birmingham, Ala. He replaces F B Carney, who resigned.

William M Dougherty is elected secretary of **U. S. Rubber Co** to succeed the late Eric Burkman. In addition, Walter F Spoerl becomes general sales manager for all divisions under Ernest G Brown's supervision. Robert D Gartrell is named development manager for all divisions and Wesley

BELCO FULLY AUTOMATIC WATER SOFTENER INSTALLED IN MIDWESTERN MUNICIPALITY



The most recent advancement in automatic water softener control is illustrated above in the Belco motor operated single control valve. This plant produces 1.25 mgd of soft water with exceptionally low operating cost and minimum maintenance.

The unique features of the Belco Multiport Valve are that rubbing rotors are completely eliminated, pressure losses are reduced to a minimum and the high mechanical advantage makes it feasible to use a low H. P. electric motor for valve functions.

The saving in pumping and electrical costs for operating the multiport valve as well as the low chemical cost utilizing Belcolite Resins have resulted in a far more economical plant.

MODERNIZATION RESULTS IN LARGE OPERATING SAVINGS

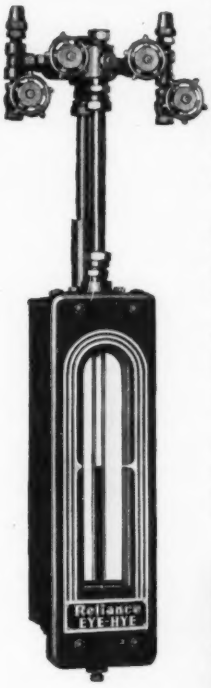
The Belco automatic valve and Belcolite Resins can be applied to existing water softening installations to lower maintenance and chemical costs to such a degree that in most cases they will repay the original expense in a few months.

BELCO INDUSTRIAL EQUIPMENT DIVISION, INC.
56 Iowa Avenue Paterson 3, N. J.
Midwest: Deady Chemical Co., Kansas City, Mo.
South: Gulf Engineering Co., Inc., New Orleans, La.
Florida Industrial Equip. Distr., Miami, Fla.
Southwest: Watermasters Inc., Houston, Texas
Pacific: Deady Chemical Company, Los Angeles, Cal.

Belco

PROCESSES FOR REMOVAL OF WATER IMPURITIES

Know your water levels— every minute— with Reliance EYE-HYE Remote Reading Gage

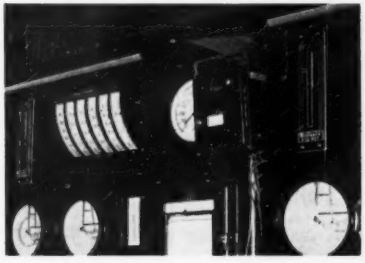


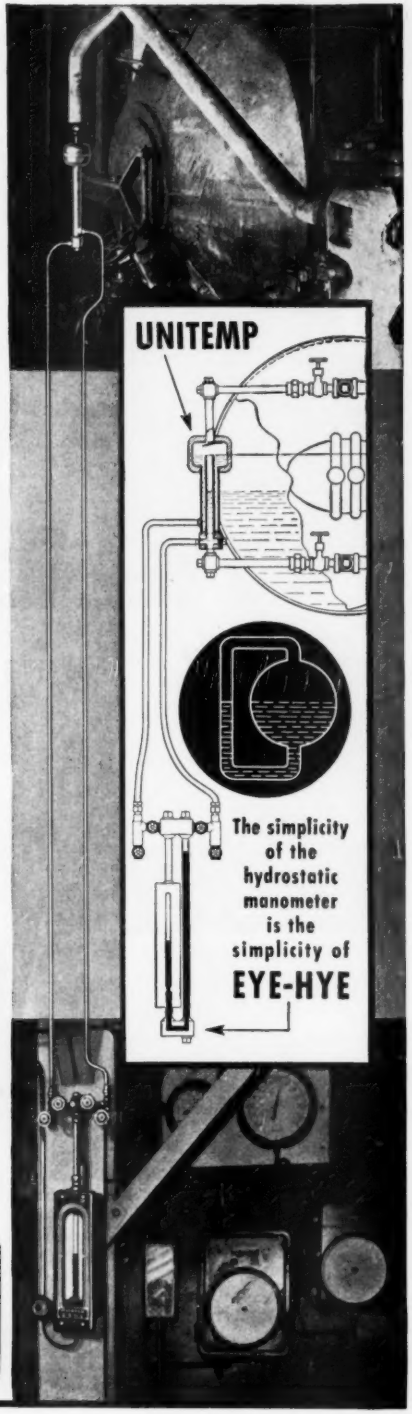
. . . All models have handsome face plates that panel-mount well with instruments.

MAKE YOUR BOILER and power plant safer from water level failure. Provide an EYE-HYE for each boiler. It's the remote reading gage that engineers can't miss seeing, frequently—a reliable, accurate device that carries water level reading to panel or convenient wall position. Reads like the usual gage, but its message is caught faster, surer because indication is sharp: green fluid brilliantly illuminated.

Simplicity is the secret of EYE-HYE's dependable full-range accuracy—all hydrostatic operation, no mechanical working parts. Factory-calibrated to your water level range and working steam pressure—cannot be tampered with. Nothing to adjust during installation. Easy to install, practically no maintenance. Complete "Unitemp" temperature equalizing unit is furnished with each EYE-HYE.

Reliance EYE-HYE is a familiar sight in thousands of power plants. Various models fit any remote gage need—any pressure. Write the factory or nearest Reliance Representative for more details.





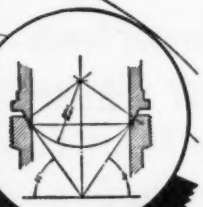
BOILER SAFETY DEVICES since 1884

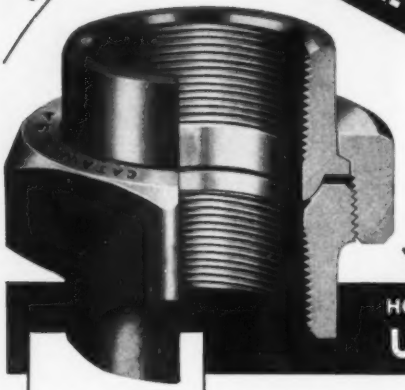
Reliance®

THE RELIANCE GAUGE COLUMN CO. • 5902 CARNEGIE AVENUE • CLEVELAND 3, OHIO

CATAWISSA

BALL-TO-ANGLE SEAT gives you a PERFECT SEAL...





. . . even when the pipe is not perfectly aligned!

CATAWISSA

HOT FORGED STEEL

UNIONS

Full ACME Threads or U. S. Standard V-Threads in Union nuts and on female end.

STANDARD AND DOUBLE EXTRA HEAVY

HOT FORGED from solid, rectangular steel bars, Catawissa Pipe Unions are free from sand and blow holes. The ball-to-angle seat design plus their ability to expand and contract with the pipe give you sure fire dependability . . . a perfect seal for every application!

CATAWISSA

STAINLESS STEEL

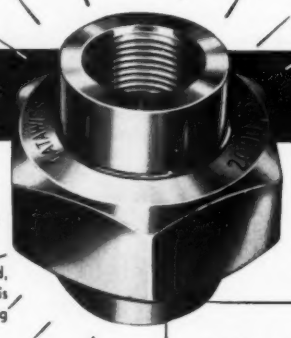
UNIONS

a type for every use!

MACHINED FROM SOLID STAINLESS STEEL BARS

Types 304, 316 and 347

Wherever caustic solutions are piped, Catawissa pipe union dependability is now available in corrosion-resisting Stainless Steel!



U. S. Standard V-Threads in Union nuts and on female end.

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A Armstrong is appointed **production manager.** Frederick S Bartlett is now **factory** manager of the company's Bristol, R. I. plant.

U. S. Rubber has also assigned several new sales managers to their respective territories as follows: C W Short—Boston; J D Drohan—New York; H J Cluver—Philadelphia and Baltimore; C C Hronek—Atlanta, Birmingham and New Orleans; E W Renfree—Detroit, Cleveland and Pittsburgh; G E Hubrig—Chicago, Milwaukee and Minneapolis; A B Gangwer—Kansas City, Tulsa, Omaha and Denver; R S Keith—Dallas and Houston; L M Guibara—Los Angeles, San Francisco, Portland, Seattle and Salt Lake City.

Westinghouse Electric Corp appoints G L MacLane Jr assistant manager of engineering laboratories and standards dept, and Dr L J Berberich manager of liaison section of this dept.

William A Nelson joins **Turbine Equip Co,** New York City, representatives of De Laval Steam Turbine Co, De Laval Separator Co, Cochrane Corp, Yeomans Bros and Peerless div of Food Machinery and Chemical Co, in this area.

Warren Steam Pump Co has chosen Ira Rosin, 3751 Prospect Ave, as its Cleveland representative. Territory includes northern and central Ohio and Erie, Pa.

J B Crawford assumes duties as plant manager of new **Union Asbestos & Rubber Co** plant at McGregor, **Texas.**

A B Judd Supply Co, Houston, **Texas,** has been appointed a distributor of welding fittings and flanges for **Tube Turns Inc.**

Vincent Vandervoort is elected **vice-president** of **Marlow Pumps,** Ridgewood, N. J.

William A Schaub becomes manager of Denver district of industrial products sales dept of **B F Goodrich Co** and Raymond P Russell is manager of the Boston district. Russell succeeds John M Cooney who is now manager of Akron, Ohio district.

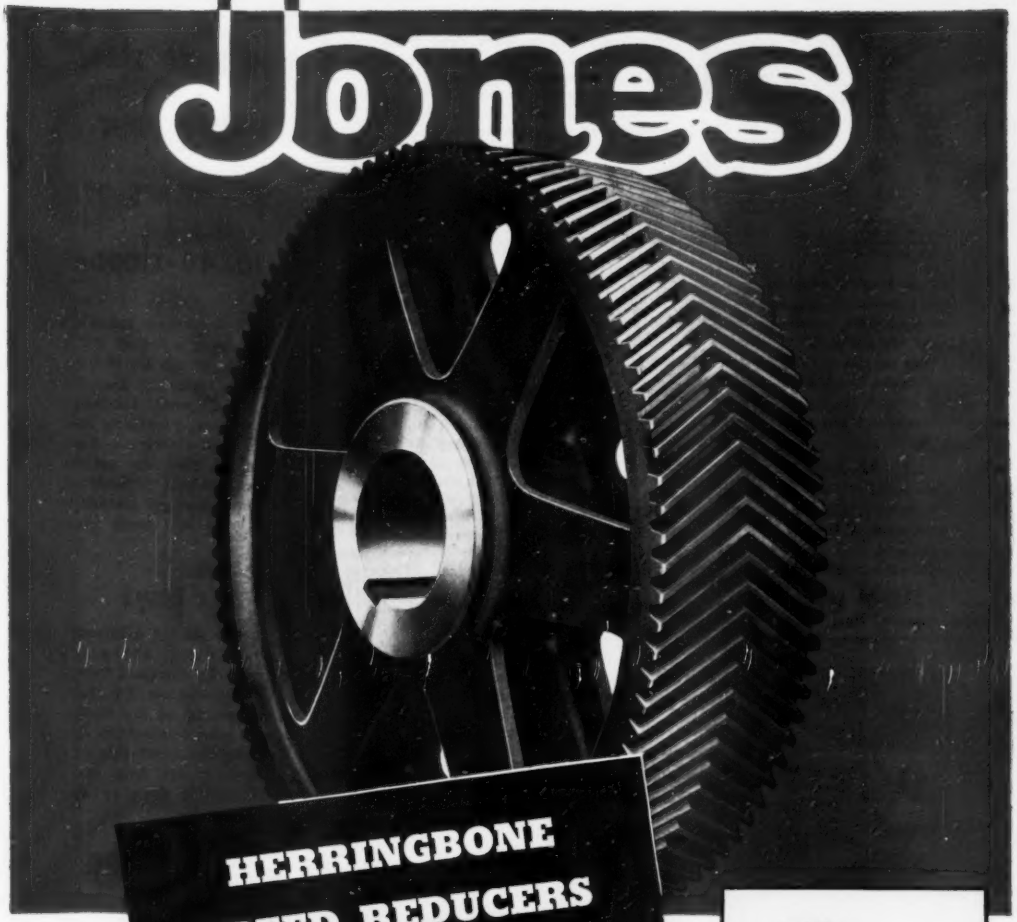
Sam Tour & Co has reorganized its mechanical engineering dept under supervision of John J Meadows, PE, who has just joined the organization. Harold F Stose is new head of chemical engineering dept.

Dr Ralph L Nuttall is assigned to staff of **National Bureau of Standards,** where he will do research on thermal conductivity of gases at elevated temperatures and pressures in the thermodynamics lab.

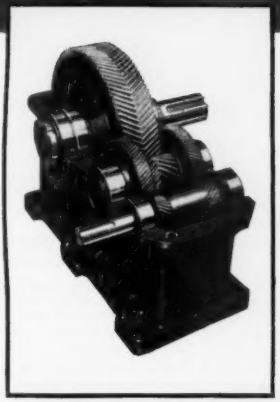
Missouri Gas & Electric Service Co names Murray C Boogher to succeed the late A G Beisenherz, as vice-president and general manager.

West Penn Power Co, Pittsburgh, Pa., elects Howard S Fitch vice-president and director. He assumes full responsibilities for management of the power dept, formerly under Allen N Cartwright. Cartwright continues as vice-president and director of the company and holds his offices in subsidiary companies, rendering consulting and advisory service on technical matters related

Jones



HERRINGBONE SPEED REDUCERS



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If any of our products or engineering service will be helpful to you we shall do our best to render as much assistance as possible. Our Bulletin No. 80 "Jones Drives for Industry" will give you a clear picture of our transmission products and manufacturing facilities. Your request will bring a copy by return mail.

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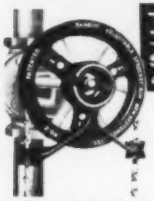

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to engineering and construction. Joseph O Chambers is also elected a vice-president continuing in his responsibility of management of the operating dept.

Other promotions in **West Penn Power** are as follows: J E Fife, manager of power supply, is responsible for system planning and system operation. He will supervise electrical engineering and the electrical construction and maintenance of power stations and substations. R W Hurd succeeds Fife as manager of northern div at Kittanning, Pa. D T Faust becomes western div manager with headquarters in Washington, Pa. Robert W Cranston is promoted to general superintendent of substations.

Aloysius C Marcero, superintendent of Coaners Creek plant of **Detroit Edison Co,** retires after 35 years of service with the company. Also retiring is Wesley W Break, plant engineer of the company's central heating plant on Beacon St. Marcero's place will be taken by Albert C Pasini, and Break's by Edmund M Brown.

Franklin S Helfter of Charles R Huntley Steam-Electric Stations of **Buffalo Niagara Electric Corp,** is advanced to general superintendent of steam stations. As such, Helfter and his staff will have general supervision of the Dunkirk Steam Station now being erected, as well as the Huntley plant. He will be assisted by William G Godfrey, assistant superintendent. Steam operations of the combined plants will be under direction of Daniel P Wendel and electrical operations under Elmore W Popp. Maintenance of equipment will be supervised by Elmer F Keil and coal handling by Jacob H Reiser. Performance records and results are prepared and coordinated by Herbert J Thielke, while supervision is under Julius M Kieffer.

In addition, P Allister Burt will become station superintendent of the new Dunkirk plant of **Buffalo Niagara.** Burt, at present, is on special operational studies as assistant to superintendent of Huntley Stations. Edward K Morrison, chief boiler operator at Huntley, will be in charge of operations at Dunkirk.

Ralph D Jennison, of **New York State Electric & Gas Corp,** has been elected chairman of the board. In this capacity he continues as chief executive officer. Joseph M Bell Jr, manager of Public Utilities securities for Equitable Life Assurance Society of U. S., replaces Jennison as president of the company. Bell has also been elected a member of the board of directors and member of executive committee. Arnold W Milliken has been made general manager, and David A Lewis general operating superintendent. Lewis will continue to make his headquarters in Binghamton.

Industrial Unit Heater Assn elects following officers for the ensuing year: *President*—H S Wheller, president, L J Wing Mfg Co, New York City; *vice-president*—L D Mandell, vice-president, C A Dunham Co, Chicago; *secretary-treasurer*—L O Monroe.

National Assn of Fan Manufacturers announces following officers for the ensuing year: *President*—Edgar F Wendt, president,

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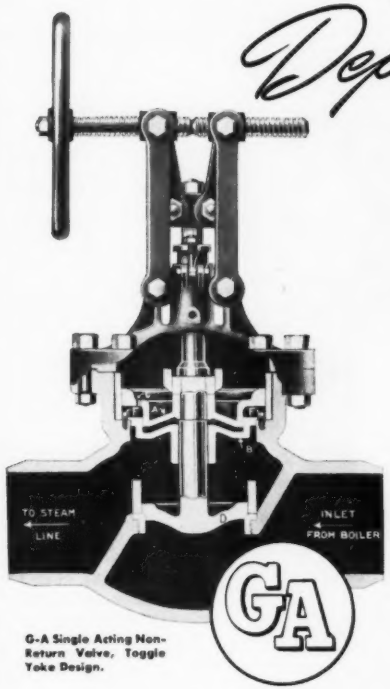

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Buffalo Forge Co, Buffalo; *vice-president*—R A Wasson, vice-president and general manager, Clarage Fan Co, Kalamazoo, Mich.; *secretary-treasurer*—L O Monroe.

Frank T Sisco, director, Alloys of Iron Research, has been appointed technical director of **Engineering Foundation.**

OBITUARIES

Othmar K Marti, 57, consulting engineer for Allis-Chalmers Mfg Co, died Feb 15 after a short illnes.

Paul Fielden, 62, director of purchases of Norton Co, died Feb 6 in Worcester, Mass.

Eric Burkman, 56, secretary of U. S. Rubber Co, died Feb 26 while on vacation in St. Thomas, Virgin Islands.

M Errol Gordon, 55, secretary and treasurer of Frick Co, Waynesboro, Pa., died Feb 14 in the Waynesboro hospital after a brief illness.

Charles D Dill, 61, Buffalo district service representative for Diamond Power Specialty Corp, died Feb 15 at his home in Buffalo, N. Y.

Charles G Price, 51, purchasing agent for past 11 years with Armstrong Cork Co, Lancaster, Pa., died March 2.

Winfred W Elliott, founder of Elliott Mfg Co, Binghamton, N. Y., died Jan 26 after a long illness.

Elmore H Schiemann, 48, mechanical engineer, associated with Pioneer Service & Engrg Co for many years, died suddenly Feb 11 while on a train returning to Chicago from a business trip.

Betrand R T Collins, 82, formerly a staff member of Stone & Webster Engrg Corp, Boston, and later of Spray Engrg Co, Somerville, Mass., died March 3 in Princeton, N. J.

Ralph P Worden, former president of Worden Corp, industrial engineers, Boston, Mass., died Feb 9 in Clearwater, Fla.

George W Rexford, 76, chief engineer for Hotel Hamilton, Utica, N. Y., died Feb 21.

AWARDS TOTALLING $500 have been given to eleven **Dravo Corp** employes for writing the best papers submitted in the company's 10th annual technical papers competition. Checks were presented to the winners during the Dravo Engineers Club stag social at the University Club, Pittsburgh. Top prize of $150 was taken by Orval Auhl, general superintendent of Dravo's Contracting Division, for a paper on the construction of Bluestone Dam, Hinton, W. Va., which was completed last December by Dravo.

Standard steel lists combined in one data folder are offered by **The Babcock & Wilcox Tube Co,** Beaver Falls, Pa. Chemical compositions are given for basic open-hearth and acid-bessemer carbon steels and resulphurized steels, for open-hearth and electric-furnace alloy steels and for stainless and heat-resisting steels, all subject to standard variations for check analysis. Giving the AISI number with the SAE number, these are convenient lists for cross reference. Technical data card No. 119 is available free on request.

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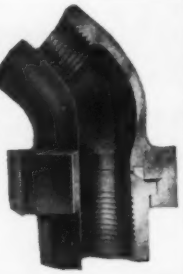

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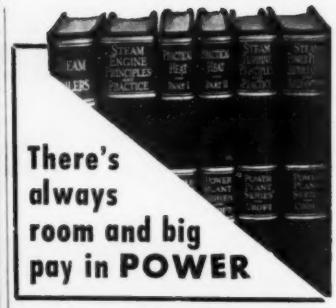

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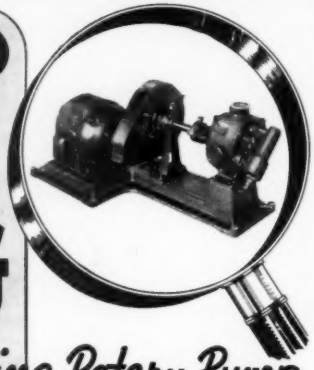

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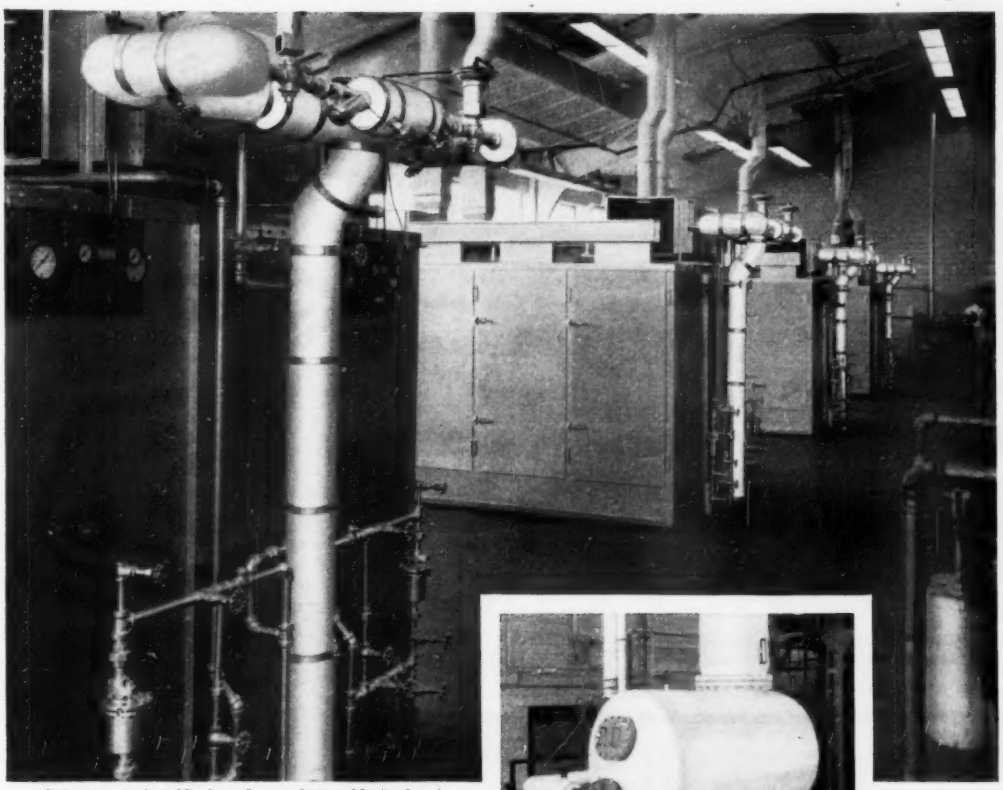
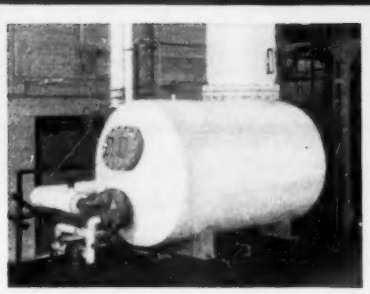


Drying closets in plant of The Bayer Company Division of Sterling Drug, Inc., Trenton, N. J. The 60-lb. steam pipes are covered with K&M "Featherweight" 85% Magnesia Insulation, 2 inches thick, canvas pasted and banded.



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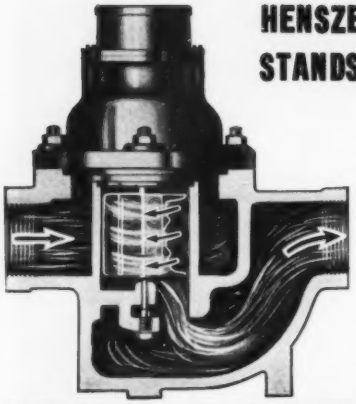

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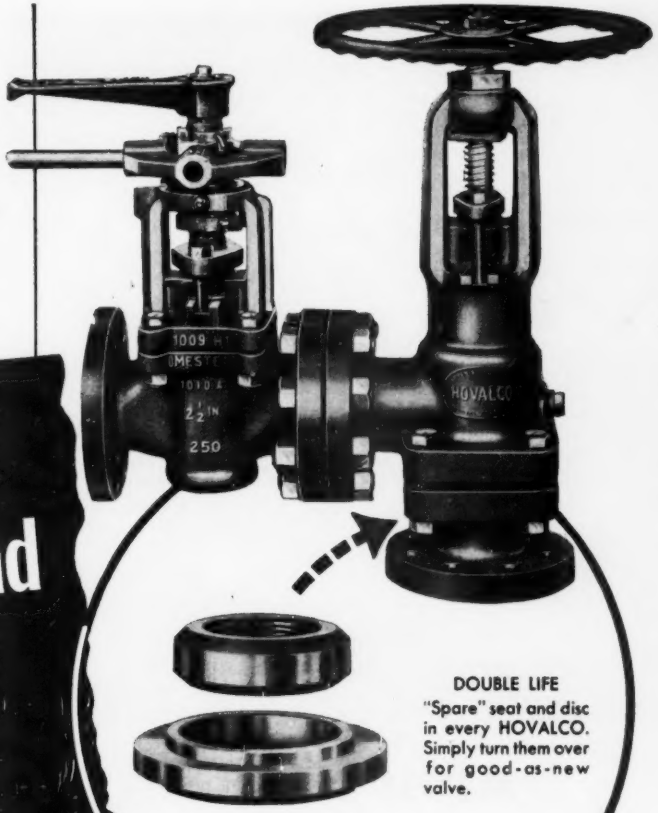

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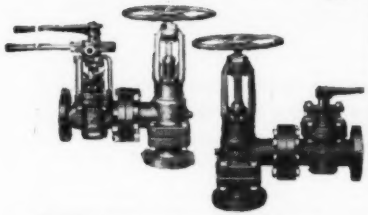
This Extra Seat and Disc MEANS DOUBLE SERVICE LIFE



HOVALCO angle valves used in combination with (1) Homestead Lever-Seald or (2) Cam-Seald Quarter-Turn Valves, meet the requirements of A.S.M.E. Code and all state laws for boiler blow-off service. Made in 1½"—2"—2½" sizes for pressures up to 600 pounds.

HOVALCO HOMESTEAD COMBINATION BLOW-OFF VALVES are built to outlast the boiler. Records of 25 to 30 years' continuous use in boiler blow-off service are common, and besides having double the life span of ordinary valves, they cost 30% to 60% less to maintain.

The HOVALCO ANGLE VALVE which takes the abuse and regulates the flow, is equipped with a special *reversible*, long-wearing, "S" Monel seat and disc . . . actually an *extra* set of accurately ground, perfectly matched seating surfaces ready to be put into service whenever the need arises. By simply unbolting the lower valve body and turning over the seat and disc, you have a good-as-new valve ready for another long lifetime of service.

Write today for full information and your copy of Valve Reference Book No. 38.

HOMESTEAD VALVE MANUFACTURING CO.
Serving Since 1892
P. O. BOX 210 CORAOPOLIS, PENNA.

After the sale . . . what?

You've, no doubt, heard the time-honored sales stimulator—"To sell is to serve".

At American Blower, this is borne out on every order.

Here, in consultation, are shown A. P. Darlington and H. O. Danz, both veterans of 34 years with American Blower. They're starting work through the shop on a new order for Induced Draft Fans from The Detroit Edison Company for the Conner's Creek Station.

American Blower engineers have sold and served Detroit Edison on similar orders all through the years.

It has been their privilege to work closely with Detroit Edison engineers during this time (sometimes in overalls right on the jobs). They have profited by this experience.

Yes, you've guessed it. They sell by serving.

This service is available to you through equally competent American Blower sales engineers located in our branches in all the principal cities. A phone call will put you in contact with one.

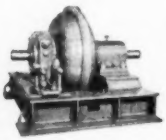
AMERICAN BLOWER CORPORATION, DETROIT 32, MICH.

CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary corporation

HS and Sirocco Fans for forced or induced draft in all types of power plants.

ST Fly Ash Precipitators—especially for power plants burning pulverized fuel.

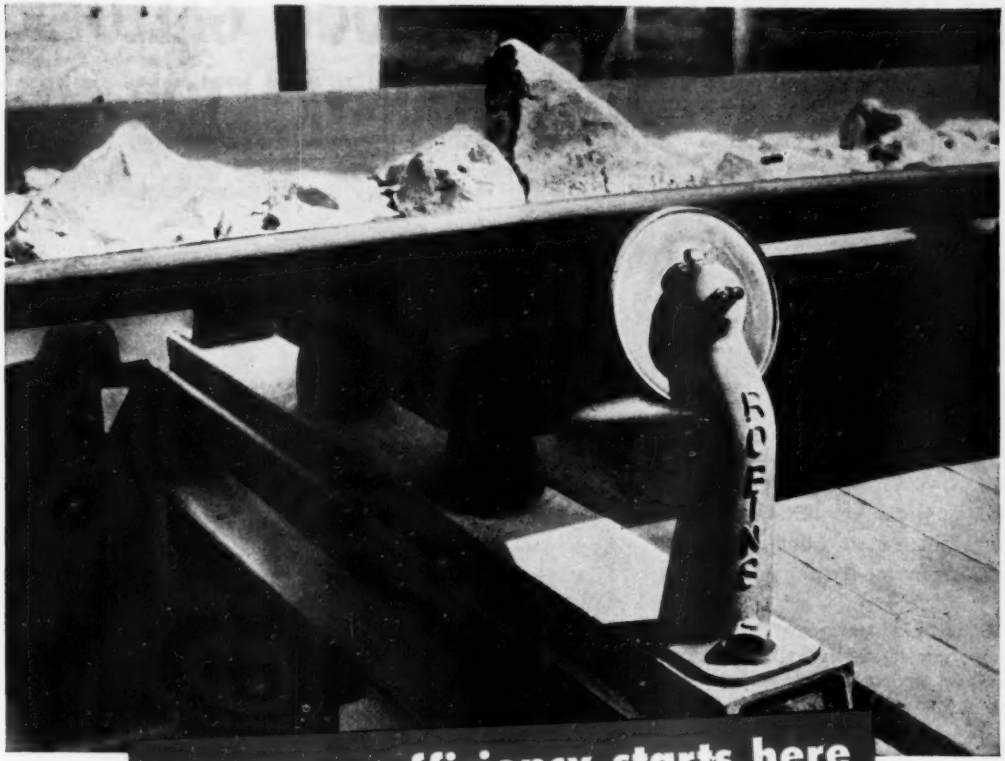


Type VS Gyrol Fluid Drive—for adjustable speed control of mechanical draft fans.

AMERICAN BLOWER

Serving home and industry

AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILER • ROSS HEATER • TONAWANDA IRON



Conveyor efficiency starts here

Your conveyor can be no better than its idlers!

For the idlers must do two things: (1) They must withstand severe usage. (2) They must keep your conveyor belt tracking properly. Otherwise, your entire conveyor can break down.

Yes, efficient idlers are vital to top performance. And because Hewitt-Robins Conveyors are equipped with Robins Idlers, you can depend on them to *move your material at less cost.*

You see, Robins Idlers provide *extra strength.* The reason is their rigid truss design. It is stronger than any other type of construction!

Robins Idlers provide *extra economy,* too. That is due to such features as their patented One-Shot Lubrication and Triple Grease Seal. These enable Robins Idlers to roll longer . . . with less care and less grease!

Here's an additional fact to keep in mind when you buy a conveyor:

Hewitt-Robins is the only company in the world that assumes complete responsibility for both machinery and belting. Only Hewitt-Robins engineers builds and installs these elements as a single unit.

Whether you need replacement idlers for your present conveyor or an entirely new conveyor, insist on Robins Idlers. For full details, write Robins Conveyors Division, 270 Passaic Avenue, Passaic, New Jersey.

ROBINS

IDLERS

ROBINS CONVEYORS DIVISION

These exclusive features of Robins Idlers save you money

One-Shot Lubrication

Cuts your lubricating time more than half. Assures thorough lubrication with only one walkway on your conveyor. No exposed piping subject to damage.

Triple Grease Seal

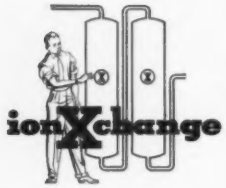
on Robins Roller Bearing Troughing and Return Idlers. Locks grease in. Keeps dirt and moisture out.

Rigid Truss Construction

End and center brackets, pulleys and pulley shafts form a single unified member that absorbs shocks and loads. Stronger than any other type of construction!

HEWITT-ROBINS HR **INCORPORATED**

BLOW-DOWN CUT 100,000 GALLONS PER DAY AT CATERPILLAR TRACTOR CO.



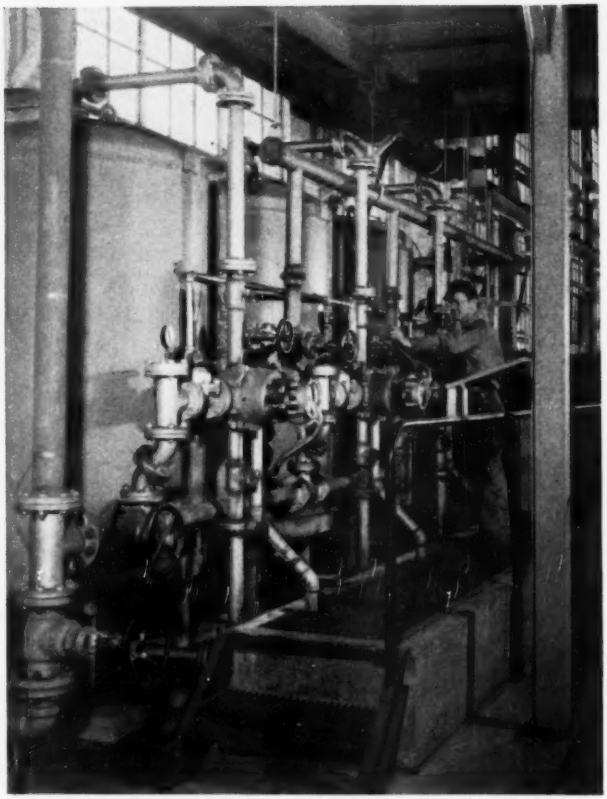
ILLCO-WAY's simplified modern boiler water conditioning system cuts steam costs, boosts efficiency at Caterpillar Tractor Co. plant

"Caterpillar" operates twelve 630 H.P. boilers on de-alkalized water. The boilers can be operated at 200% capacity, or at 1260 H.P.

Use of ILLCO-WAY equipment, shown at right, has reduced blow-downs by approximately one-half of former requirements. Continued use of de-alkalized water is expected to produce even greater blow-down reduction in the future.

In nine months of operation the savings on make-up water have been very pronounced, Caterpillar reports. During normal operations, an estimated 100,000 gallons per day on make-up water are saved by using ILLCO-WAY equipment, as the result of elimination of excessive blow-down.

ILLCO-WAY De-alkalizing equipment produces water suitably low in alkalinity, reduced in solids content, and free or hardness, at a cost comparable to softening. Write for literature today.



ILLCO-WAY De-alkalizing installation in power plant at Caterpillar Tractor Co., Peoria, Illinois

Together to serve you better!

ILLCO-WAY

DE-IONIZING
DE-ALKALIZING
SOFTENING

Elgin
ELGIN ILLINOIS

ELGIN WATER CONDITIONING

Services and products of Elgin Softener Corporation have been added to those of ILLCO-WAY—thus broadening our range to include Elgin Zeolite Water Softeners, Water Treating Chemicals, Filters, and the complete line of Elgin Water Conditioning Systems for every need.

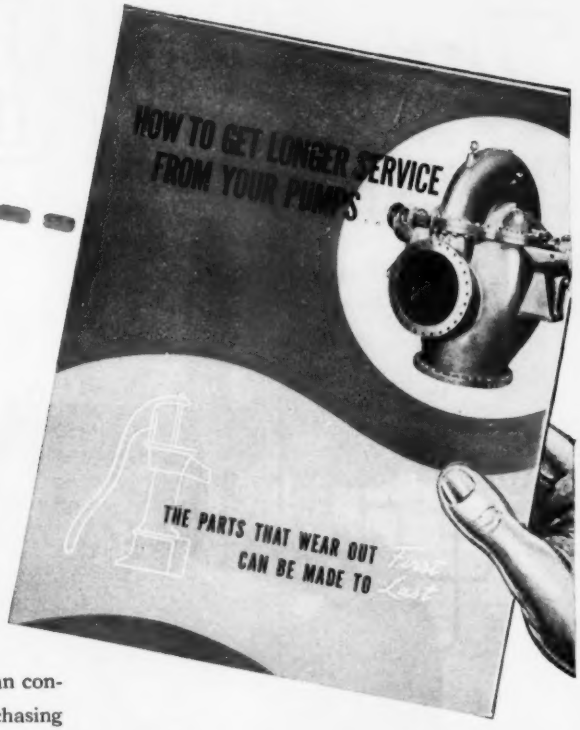
ILLINOIS WATER TREATMENT CO., 853-5 Cedar St., Rockford, Illinois • 7310-NN5 Empire State Bldg., New York

Illco-Way and Elgin representatives in principal cities

ENGINEERING AND EQUIPMENT—DE-IONIZERS for process water treatment and treatment of liquids and solutions other than water; waste treatment; reclamation of specific constituents. DE-ALKALIZERS: Boiler feed (external); Bottling water. SOFTENERS: Industrial, Domestic. **FILTERS, etc.**

FREE...

VALUABLE INFORMATION FOR PUMP USERS



Here is a new booklet, just off the press, that belongs in the files of every man concerned with operating, maintaining, or purchasing pumping equipment.

Case histories drawn from important industrial fields, show how pump operators and manufacturers have successfully dealt with those long-time enemies of pump life—corrosion, fatigue, and excessive wear.

You'll find these stories well worth reading . . . and they may suggest a solution to your own pump problems.

Meanwhile, if you are looking for ways to improve your pump installations, or are contemplating buying new ones, here is a tip worth remembering:

Most pump users agree that pump parts last longer when they're made of *Monel*, "K"* Monel, or "S"* Monel.* And that's not surprising, for these Inco Nickel Alloys have strength and fatigue resistance equal to that of structural steel. They are rustproof, hard, and corrosion-resistant as well.

These Inco "task" Alloys bring you other important advantages, too. For a more complete discussion of their desirable physical properties in pump applications, send for the new booklet . . . today.

Just mail the coupon. *Reg. U. S. Pat. Off.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

EMBLEM OF SERVICE
INCO
TRADE MARK

***Monel*... for minimum maintenance**

THE INTERNATIONAL NICKEL COMPANY, INC.
67 WALL STREET, NEW YORK 5, N. Y.

Please send me your new booklet: *"How to Get Longer Service from Your Pumps."*

NAME .....

TITLE P5-49

COMPANY .....

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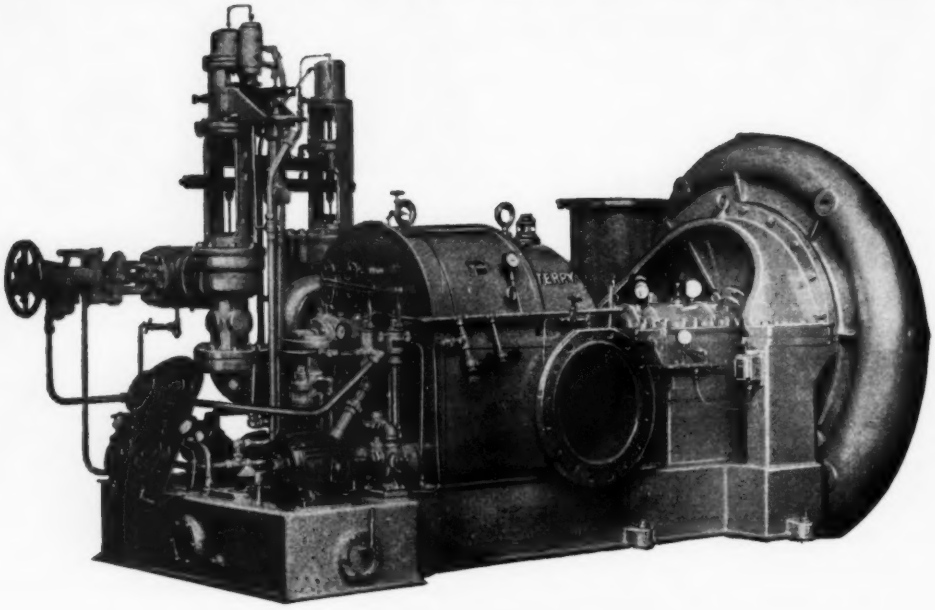
The TERRY TURBINE



SPECIAL PURPOSE TURBINE

FOR OPERATION UNDER ALL THESE CONDITIONS:

1. Straight, high-pressure, condensing
2. Straight, low-pressure, condensing — putting to work excess low-pressure steam.
3. Mixed pressure — using the low-pressure steam available, with only enough high-pressure steam required to drive the compressor
4. Condensing bleeder operation — providing clean, low-pressure steam for heating or process work

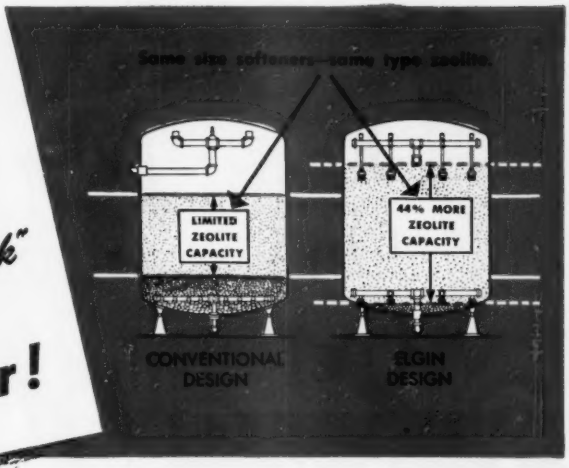
. . . and the speed under any of these conditions can be varied from 2800 to 4750 rpm.

This is but one example of many unusual combinations developed by Terry to meet out-of-the-ordinary requirements in turbines up to 2000 hp. Information on a special-purpose turbine for your specific requirements will be gladly furnished.

T1177

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

9 out of 10 prefer the ELGIN "Double-Check" Water Softener!



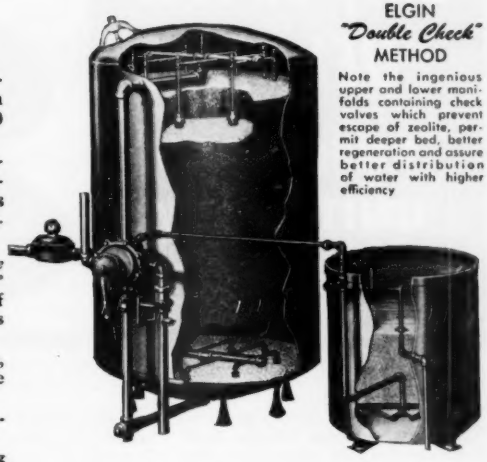
A record of the preference expressed by nearly 2000 operating men who weighed the Elgin "Double-Check" design against the conventional design, shows that 9 out of 10 prefer the "Double-Check"!

Study the diagrams above, contrasting the Elgin "Double-Check" design with the conventional zeolite water softener, and you will see why the "Double-Check" design is so overwhelmingly preferred. In comparison with the conventional softener the "Double-Check" means:

1. *More soft water.* Up to 44% more soft water from *same* size softener containing *same* type zeolite. "Double-Check" manifold permits putting more zeolite in a softener of given size; also permits higher back-wash rate which means more efficient use of the larger amount of zeolite.
2. *Eliminates zeolite loss.* By preventing escape of zeolite, the "Double-Check" design virtually eliminates zeolite replacement cost.
3. *Positive backwash control.* Backwash rate automatically regulated by Elgin backwash regulator.
4. *Less salt and wash water.* More efficient backwashing reduces wash water consumption; also assures more efficient regeneration that cuts salt consumption.
5. *Less maintenance.* Elgin quality construction means minimum repairs and replacements.
6. *Smaller space required.* More soft water from softener of given size means either added capacity from same size softener or same capacity from a smaller one

Ask for Bulletin 607. It shows why 9 out of 10 prefer Elgin "Double-Check".

ELGIN SOFTENER CORP., 130 North Grove Ave., Elgin, Ill.



ELGIN *"Double Check"* METHOD

Note the ingenious upper and lower manifolds containing check valves which prevent escape of zeolite, permit deeper bed, better regeneration and assure better distribution of water with higher efficiency

Step up capacity of your present softener

Remember that the Elgin "Double-Check" method is adaptable to all makes of softeners. Let us show you how we can step up the output of your present softener (as much as 3 to 10 times with the "Double-Check" method and our new high capacity synthetic and resinous zeolites).

ELGIN ECONOMICAL WATER CONDITIONING

GET THE FACTS . . .

Send Bulletin 607. I am interested in:

☐ Elgin Water Softener. ☐ Modernizing our water softener.

NAME_____

COMPANY_____

ADDRESS_____

Mail to—ELGIN SOFTENER CORPORATION, Elgin, Illinois

SOFTENERS • CHEMICAL TREATMENT • FILTERS • BOILER WATER CONDITIONING

Easy On Your FUEL BILLS

PREFERRED UNIT STEAM GENERATORS

The E. T. Wright factory at Rockland, Mass. — where Wright *Arch-Preserver* shoes are made — is heated by an economical Preferred Unit Steam Generator.

This Wright installation was tailored to specific job requirements by Buerkel & Co. of Boston, contractors and engineers, to provide dependable, automatic operation with low maintenance and maximum efficiency. Hundreds of custom-built Preferred Units are generating low cost steam, *often cutting fuel bills as much as 40%*. Preferred Generators also eliminate costly stacks . . . reduce repair bills . . . help avoid expensive shutdowns.

Investigate the application of a Preferred Unit Steam Generator to your specific requirements. You'll find the full story on why Preferred Generators use less fuel, require less attention, in our new bulletin 1000-F. Write for your copy today.

ENGINEERING FEATURES

1. Fully Automatic Operation even with Bunker C, No. 6 including the new catalytic residuals and all types of commercial gas.

2. Induced (Pull-through) Draft, a distinctive feature, eliminating the necessity of building costly stacks. Only a simple vent to the outside air is required. No escape of products of combustion into the boiler room.

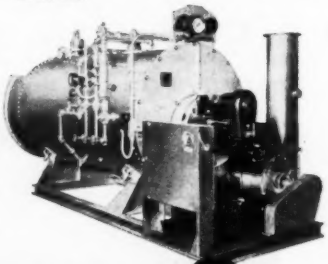
3. Preferred Rotary Oil Burner — belt driven — 4600 RPM cup speed — patented Voluvalve for dependable fuel regulation — built especially for this unit.

4. Four-Pass Down Draft Gas Travel results in maximum heat absorption.

5. 80% Minimum Thermal Efficiency proved and guaranteed.

6. Low Maintenance — the result of over 28 years of combustion engineering experience.

7. Full Range of Sizes — from 20 to 500 h.p. and pressures of 15 to 250 lbs. Two-pass units in 20 and 30 h.p. with pressure of 15 lbs.



PREFERRED UTILITIES MANUFACTURING CORPORATION • 1860 BROADWAY, NEW YORK 23, N.Y.

PREFERRED UTILITIES MFG. CORP.

R/M

Valve Stem Packing

Raybestos-Manhattan manufactures a number of special packings for valve stems and other small spaces.

R/M Braided Valve Stem Packing No. 300 is made of long fibre asbestos yarns in braid over braid construction lubricated to insure softness and pliability. It is widely used on valve stems and reciprocating rods and plungers, against either steam, air or hot and cold water. For higher pressures it is available wire inserted (R/M No. 302).

R/M High Temperature Valve Stem Packing No. 303 consists of a braided jacket of pure asbestos yarns and monel wire over a high temperature resistant plastic core. It is a proved product for high temperature applications in valves and expansion joints handling super-heated steam or gases up to 900°F.

Ask the authorized R/M packing distributor near you for a copy of the R/M Packing Catalog. He will be glad to discuss with you the complete line of R/M packings for all types of industrial equipment.

RAYBESTOS-MANHATTAN, INC.

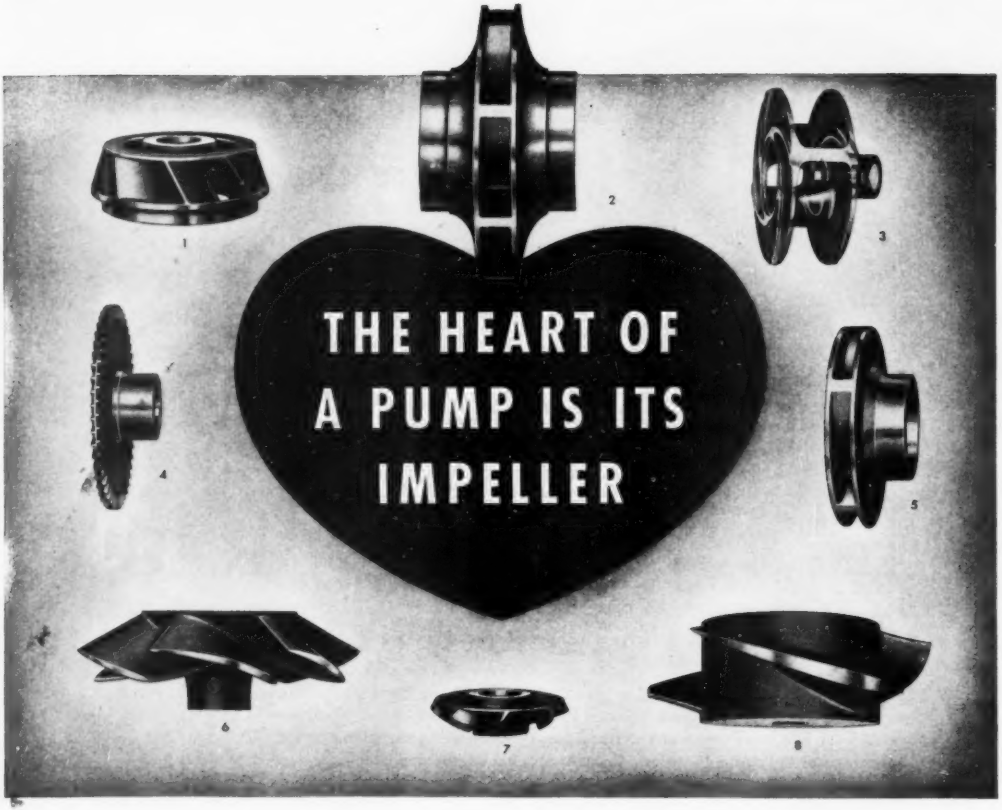
PACKING DIVISION, MANHEIM, PA.

Factories:
Bridgeport, Conn.; Manheim, Pa.
No. Charleston, S.C.; Passaic, N.J.

RAYBESTOS-MANHATTAN, INC., Manufacturers of Packings • Asbestos Textiles Mechanical Rubber Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts Radiator Hose • Powdered Metal Products • Bowling Balls

R/M

R/M No. 300



Peerless Pumps utilize many different impeller designs to meet various fluid conditions

What makes a pump "tick?" Its heart is an impeller!

Pictured above are eight Peerless impeller designs for varying fluid conditions. No. 1 forces water upward from deep wells. No. 2 is a double suction design for high capacity horizontal pumps. No. 3 pumps solids in suspension. No. 4 handles all liquids in small capacities, at high heads. No. 5 is of single suction design for process services. No. 6 combines both radial and axial flow. No. 7 is a semi-open impeller for small diameter deep wells. No. 8 is an impeller that "propels" large liquid volumes.

The point is—capacities, lifts, heads, temperatures, chemical analysis, clarity, shaft speeds are seldom common to different pump services and installations. Because fluid conditions vary, Peerless pump designers are versatile and Peerless pumps utilize this versatility in different impellers for varying fluid conditions, successfully pumping most liquids in all industries.

Peerless horizontal pumps are available for general purpose pumping, for handling sewage and other materials in suspension, for most all process services, for moving chemicals and oils, for acids and caustics and for such specialized applications as l-p gases.

Peerless vertical turbine pumps are available for lifting water from deep wells or close-coupled for wet or dry pit installation and for drainage, drydock, canal diversion and flood control services.

Plan with Peerless for all your needs for pumps. Individual descriptive Bulletins on each of the types of Peerless Pumps described above are available upon request.

Peerless
VERTICAL AND HORIZONTAL
Pumps

fmc
PEERLESS PUMPS

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
Los Angeles 31, California Indianapolis, Indiana
District Offices: New York 5, 37 Wall Street; Chicago 40, 4554 N. Broadway; *Atlanta Office:* Rutland Building, Decatur, Georgia; Omaha, Nebraska, 4330 Leavenworth Street; Dallas 1, Texas; Fresno, California; Los Angeles 31, California

Whatever the temperature...

there is a

HARBISON-WALKER REFRACTORY

for every heating zone

You get longer service from your boiler settings and reduce your maintenance costs when you select the correct refractories from the complete Harbison-Walker line.

The grade of refractory needed depends upon the individual characteristics of the furnace—the type of boiler, fuel, method of firing, operating practice. The properties you want in your refractories include resistance to fusion, fluxing and erosion, spalling and mechanical damage.

Through many years of close association with boiler manufacturers and power plant operators, Harbison-Walker has gained intimate knowledge of service requirements.

For greatest overall economy and satisfaction, standardize on Harbison-Walker refractories!

HARBISON-WALKER PRODUCTS FOR POWER PLANTS

Harbison-Walker offers a wide variety of high duty, super-duty and high alumina refractories in standard and special shapes, plastics, castables and mortars. Shipments are made from conveniently located plants or warehouses Our technical organization will gladly help you select the exact grades and types of Harbison-Walker refractories best suited to your individual needs.

Harbison-Walker Refractories Company

AND SUBSIDIARIES

WORLD'S LARGEST PRODUCER OF REFRACTORIES

GENERAL OFFICES PITTSBURGH 22, PA.

Trade Mark Reg. U.S. Pat. Off.

Where do we go from here?

NOW as never before, America stands at a cross-roads. One road is the way of easy promises by which we hope to arrive in the Never-never land of abundance for all and hardship for none.

The other way looks very much like the road we have traveled--the way that built America into the richest, strongest, most envied nation of all time. It is the road built by enterprise and resourcefulness and hard work--and thrift.

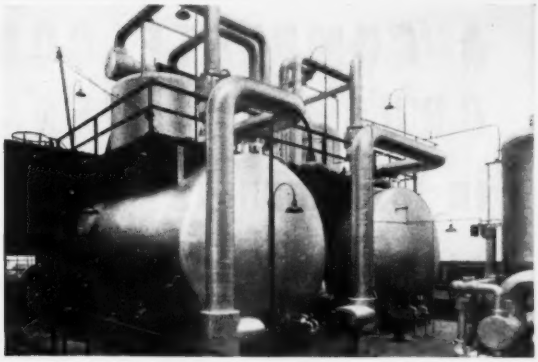
As a community leader it is your responsibility to help America choose the road we are to follow.

The Youngstown Sheet and Tube Company

General Offices--Youngstown 1, Ohio
Export Offices--500 Fifth Avenue, New York

MANUFACTURERS OF CARBON, ALLOY AND YOLOY STEELS

ELECTROLYTIC TIN PLATE - COKE TIN PLATE - WIRE - COLD FINISHED CARBON AND ALLOY BARS - PIPE AND TUBULAR PRODUCTS - CONDUIT - RODS - SHEETS - PLATES - BARS - RAILROAD TRACK SPIKES.



3600 POUNDS OF SCALE PER DAY REMOVED FROM BOILER FEED WATER

by GRAVER Hot Process Water Treating System

This is what a Graver two stage Hot Process water treating plant is doing at a large oil refinery. A million pounds of lake water per hour, taken from a canal, is treated as makeup for a battery of high pressure boilers. A million pounds of this untreated water contains approximately 150 pounds of scale forming material. This means about 3600 pounds every 24-hour day. Heaters, sedimentation tanks, filters, and deaerating equipment give the boiler system complete protection against scale and corrosion.

If your problem involves treatment of water for boiler feed, process, or industrial waste water treatment of small or large capacities . . . you will find Graver water conditioning equipment does the job efficiently and economically. *All* types are available, for all jobs, in all capacities.

Write today for recommendations and a survey of your water conditioning problem.

GRAVER

WATER CONDITIONING & PROCESS EQUIPMENT DIVISION

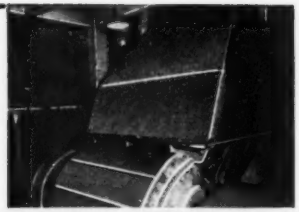
GRAVER TANK & MFG. CO., INC.

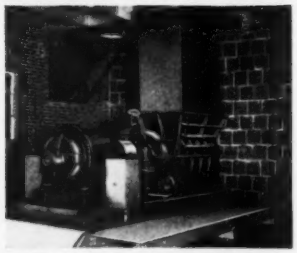
EAST CHICAGO, INDIANA

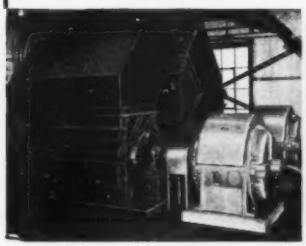
NEW YORK • PHILADELPHIA • CHICAGO • CATASAUQUA, PA. • HOUSTON • SAND SPRINGS, OKLA.

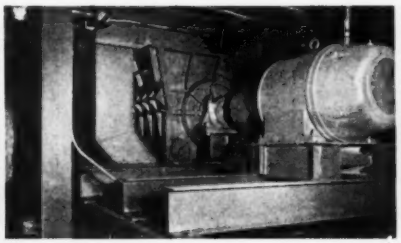
A COMPLETE COAL CRUSHING OPERATION in less than 12′ x 12′ x 12′

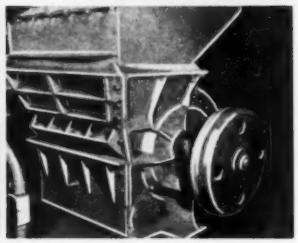
American Rolling Ring Crushers provide high tonnage reduction with controlled uniform sizing



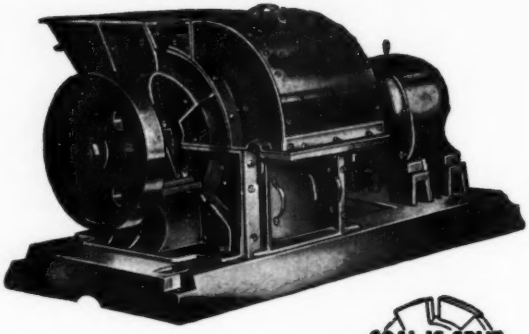








Americans are contributing to greater firing efficiency in power plants everywhere. ROM coal is rapidly reduced to stoker or pulverizing sizes in one low-cost operation. A complete, compact crushing operation requiring only minimum headroom and no auxiliary crushing or breaking units, Americans incur little or no extensive plant alterations. American Rolling Ring Crushers are built in capacities up to 500 TPH.



Only Americans offer the patented shredder ring action that *splits coal* by efficient cleavage action of multiple cutting edges.

Get the data on improved coal preparation— Send for Americans "S" Crusher Bulletin.

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1349 MACKLIND AVE.
ST. LOUIS 10, MO.

*UNIFORMITY

Under all conditions the proved performance of Tycol lubricants more than meets their recommended service.

Rigidly controlled and tested during manufacture . . . and refined from the highest grade crudes, Tycol oils and greases are known for their *UNIFORMITY within each classification — from the first drum to the last.

This unvarying high quality, plus the scope of the line, accounts for Tycol's wide acceptance by industry interested in maximum production . . . top efficiency . . . lowest operating cost.

Whatever your lubrication need, let a Tide Water Associated engineer help you select the one suited for your particular need. Call, write or wire your nearest Tide Water Associated office for full details.

TYCOL
INDUSTRIAL LUBRICANTS

Boston • Charlotte, N. C. • Pittsburgh • Philadelphia • Chicago
Detroit • Tulsa • Cleveland
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TIDE WATER ASSOCIATED OIL COMPANY
17 BATTERY PLACE - NEW YORK 4, N.Y.

*LEARN WHAT THIS PRODUCT CHARACTERISTIC MEANS TO YOU — READ "LUBRICANIA"

This informative handbook, "Tide Water Associated Lubricania," gives clear, concise descriptions of the basic tests used to determine important properties of oils and greases. For your free copy, write to Tide Water Associated Oil Company, 17 Battery Place, New York 4, N. Y.

REFINERS AND MARKETERS OF VEEDOL — THE WORLD'S MOST FAMOUS MOTOR OIL

You Can't Have Efficiency in Draft or Dust Collecting Equipment without it!

Balance . . . just as important in stack and dust collecting equipment as it is to a dancer. It costs needless time, money and effort, to try to get truly efficient operation from unrelated dust collecting and draft producing components obtained from different manufacturers.

Thermix packaged design flue gas control, balances and integrates the operation of: 1—dust collector, 2—fan, 3—breeching and 4—stack . . . provides predetermined efficiency . . . offers the added advantages of unit responsibility for draft production and dust collection.

These four important features of Thermix equipment, plus this unit design, unit manufacture and unit responsibility, protect your investment and assure operational savings for many years.

Details of Thermix equipment are available in a complete catalog. Write for a copy on your company letterhead.

All inquiries should be directed to:

Project & Sales Engineers

THE THERMIX CORPORATION

First National Bank Bldg. **Greenwich, Conn.**

(Offices in 28 principal cities)

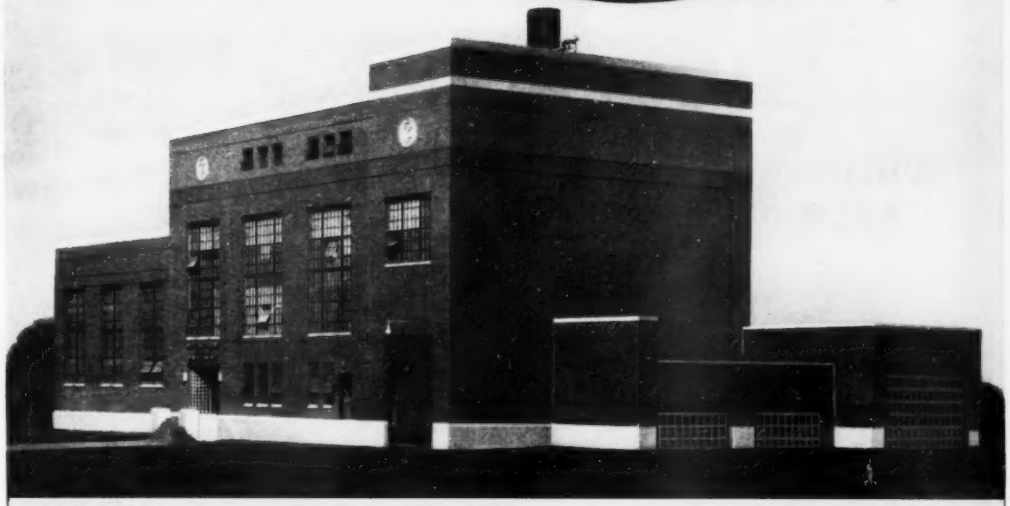
Canadian representative: **T. C. CHOWN, Ltd., 1440 St. Catherine St. W., Montreal 25, Quebec**

PRAT-DANIEL CORPORATION

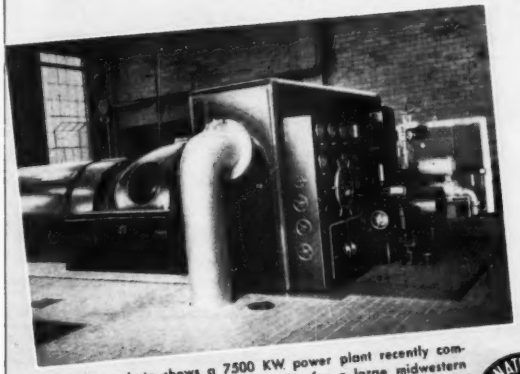
Manufacturers of Thermix Equipment

EAST PORT CHESTER, CONN.

Pritchard Built **POWER PLANTS***



*Give You Improved Efficiency—Low Cost Power



Top photo shows a 7500 KW power plant recently completed by J. F. Pritchard & Co. for a large midwestern utility. Smaller photo shows a turbo-generator installed in the plant.

Pritchard engineers are thoroughly experienced in constructing power plants in which every detail is designed for more profitable operation. Corporate utilities and industrial users of electric power know that with today's higher labor and supply costs, improved plant efficiency is essential to profit margins. Sound engineering practices, complete design facilities, mutual understanding of your problems and a willingness to cooperate with your engineers, enable Pritchard to achieve that goal for you.

If you are planning any power plants (steam or diesel), generating stations, alterations or expansions it will pay you to consult Pritchard first. Any part of Pritchard's design, engineering and construction service is also available separately. Write TODAY for complete information and competent consultation.

NATIONAL CONSTRUCTORS ASSOCIATION — MEMBER

J.F.P Co. — THREE FUNCTIONS — Design, Engineering, Construction. FIVE FIELDS — Serving the CHEMICAL, POWER, PETROLEUM and GAS industries as well as providing specialized EQUIPMENT for all industries.

POWER DIVISION

J.F. Pritchard & Co.

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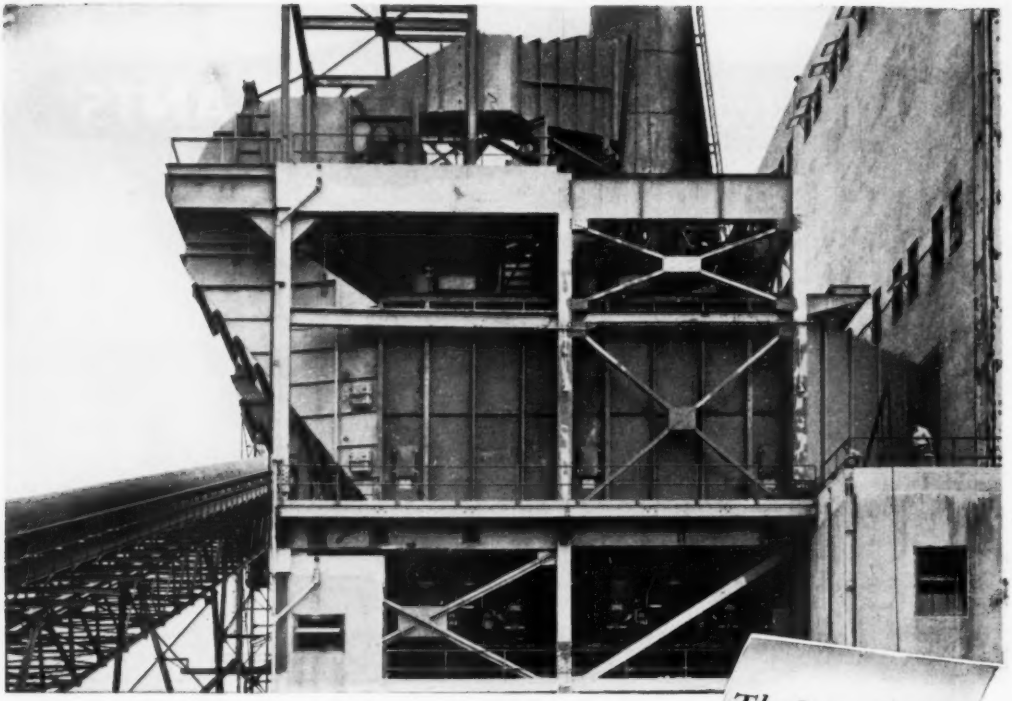


The Story Behind
KOPPERS-ELEX
Performance
GUARANTEE

How to get MAXIMUM Nuisance Abatement!

KOPPERS-ELEX electrostatic precipitators, like those in this installation, provide maximum *guaranteed* nuisance abatement . . . and improve public relations by helping make your community clean and healthy.

Although fly ash emitted to the atmosphere may vary from 0.75 to 0.25 grains per cubic foot under municipal ordinances . . . these results do not provide nuisance abatement that meets public demand. But Koppers-Elex can limit residuals to *.15 grains or less*, uniformly emitted . . . a *guaranteed* performance which protects your interests *now and in the future* by providing maximum nuisance abatement under all conditions!

Koppers-Elex precipitators assure you of *maximum efficiency* and *performance as guaranteed* . . . results of the experience gained in over 1000 successful applications. So, for superior recovery or removal of material from industrial gases, specify Koppers-Elex . . . *designed, engineered, built, installed and guaranteed* by Koppers . . . *with 111 years of reputation-building integrity behind it.* Koppers Co., Koppers-Elex Precipitator Dept., 235 Scott St., Baltimore 3, Maryland.

1st with Industrial Gas Cleaning Equipment

Koppers-Elex
ELECTROSTATIC PRECIPITATOR

KOPPERS

A
COMPLETE
Packaged
ASSEMBLY
ONLY 2 CONNECTIONS TO MAKE
Easy DOES IT
INTEGRALLY MOUNTED COMBINATION TYPE 67FR FILTER-REGULATOR NOW ELIMINATES USUAL PIPING DETAILS AND FITTINGS
Operating Medium Supply Connection
Instrument Air Connection
FISHER
DIAPHRAGM
MOTOR VALVE
It's "factory piped". Filter is bolted to yoke with two cap screw bolts.
Fisher Diaphragm Motor Valve Top Works are now regularly equipped with mounting pads for auxiliary units such as filter and positioner.
FISHER GOVERNOR COMPANY
MARSHALLTOWN, IOWA

A Cottrell Precipitator Installed by Research Corporation

WILL COLLECT OVER

95%

OF YOUR FLY ASH

A Research Corporation Cottrell will effectively clean stack gases by removing over 95% of all the different size fly ash particles suspended in the gas.

It will operate with a low draft loss, averaging only a few tenths of an inch of water across the Cottrell. The electrical power required for energizing the Cottrell is extremely low, amounting to only .5 to 1.0 KWH per 100,000 cubic feet of gas cleaned.

The *plus* efficiency of Research-installed Cottrells is assured by Research's experience gained in over 35 years and 1100 installations. This knowledge is essential to successful dust control, for every application presents its own peculiar problems. Each installation must be individually engineered.

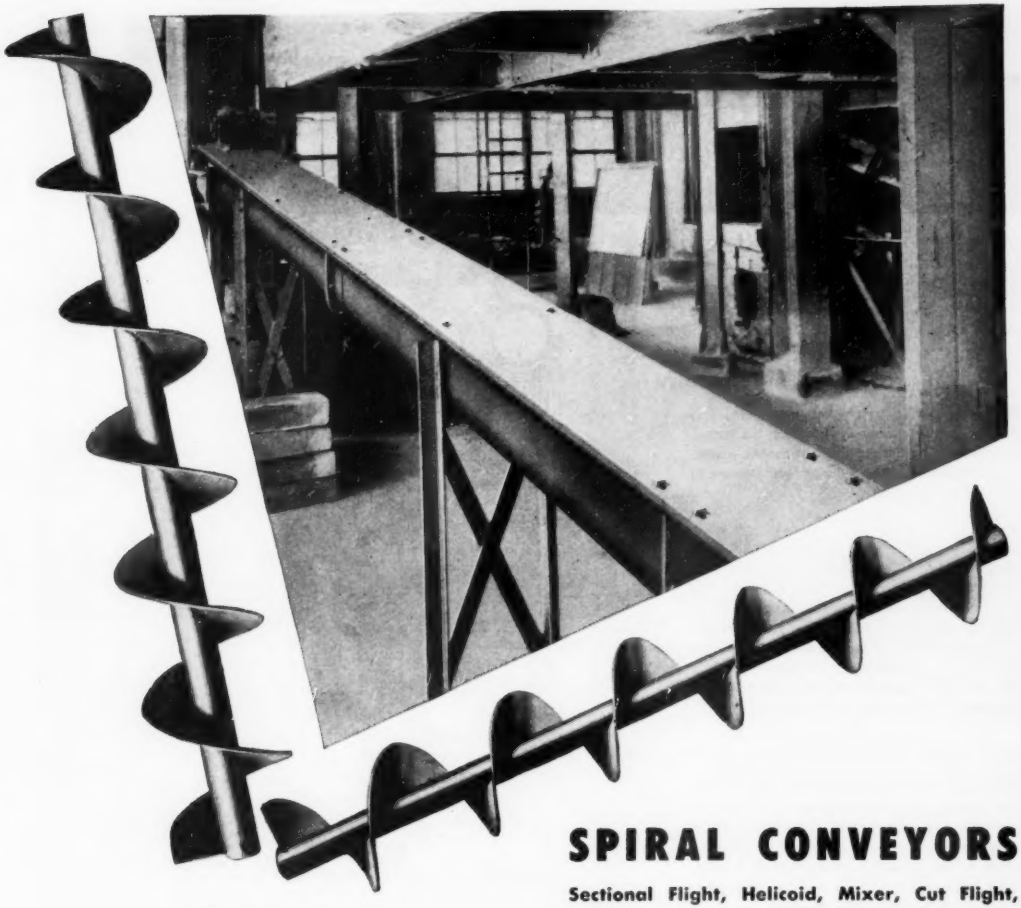
Research-Cottrells can be installed to furnish any degree of efficiency desired, and to handle any volume of boiler gas. Full information is presented in an interesting 28-page bulletin. Write for your copy today.

Research Corporation Installations

47 CARBON BLACK PLANTS
200 METALLURGICAL INSTALLATIONS
203 ACID PLANTS • 34 PAPER MILLS
262 DETARRING INSTALLATIONS
195 POWER STATIONS
71 STEEL PLANTS • 95 OIL REFINERIES
AND MISCELLANEOUS INSTALLATIONS

RESEARCH CORPORATION

405 Lexington Avenue, New York 17, N. Y.
122 South Michigan Avenue, Chicago 3, Illinois



SPIRAL CONVEYORS

Sectional Flight, Helicoid, Mixer, Cut Flight, Ribbon and Cast Iron — six types manufactured by modern methods with equipment especially designed for the purpose, insuring uniform strength and true alignment. Handle many kinds of material — capacities vary with size of conveyor. No return strand — saves time and cost. Jeffrey spiral conveyors are interchangeable with other standard makes — are built to industrial standards. Write for data.

They meet Practically Any Requirement and Operating Condition

THE JEFFREY MANUFACTURING COMPANY

Established 1877

932 North Fourth St., Columbus 16, Ohio

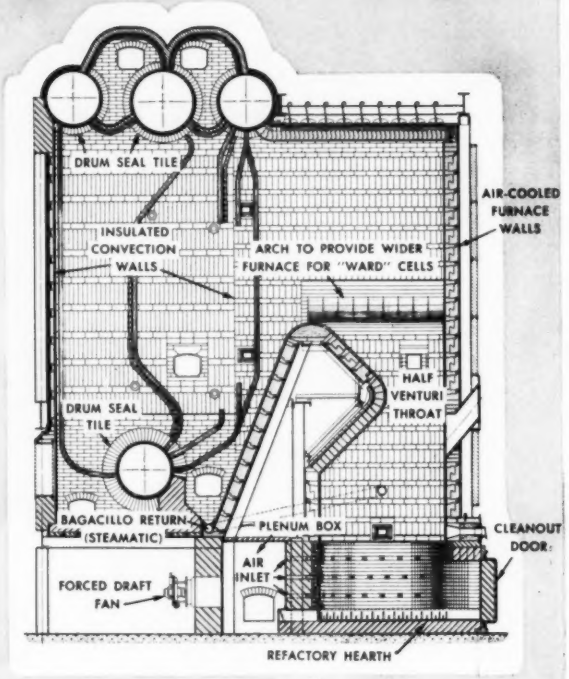
Complete Line of Material Handling, Processing and Mining Equipment

JM

Baltimore 2	Chicago 1	Detroit 13	Jacksonville 2	Pittsburgh 22
Birmingham 3	Cincinnati 2	Harlan	Milwaukee 2	St. Louis 1
Boston 16	Cleveland 13	Houston 5	New York 7	Salt Lake City 1
Buffalo 2	Denver 2	Huntington 19	Philadelphia 3	Scranton 3

enclosures designed to keep heat... *hot*

This complete enclosure presents a graphic picture of how several arch and wall thicknesses are incorporated in one unit to meet individual operating conditions.



● The suspended arch and the husky double wall in the hot furnace zone are air cooled to assure refractory survival.

● In the cooler convection area, thin suspended walls, backed up by thick insulation, minimize air infiltration and conduction losses. This combination also reduces heat storage in the walls.

● Wet bagasse (spent sugar cane) is utilized for fuel. The setting is designed to provide the proper amount of combustion air overfire to facilitate burning. These gases are burned above the Venturi throat to approximate 15% to 17% CO_2. Maintenance of this high CO_2 rate is made possible by the tight insulated thin walls in the convection area.

● A hopper under the boiler convection section catches unburned particles of bagasse for return to the firing zone via an automatic steam-operated injection system. An important factor is the substantial reduction of foundation loads; suspended construction inherently is much lighter than solid masonry.

Swirling hot gases really do their work in this Ward-type furnace specified by a Latin-American sugar mill for a bent tube boiler. Heat stays in; air stays out; refractory maintenance is virtually eliminated. This contrasts to the old practice of substantial yearly maintenance of solid refractory settings after each grinding season.

Want more information? This same engineering "know how" can be applied to any kind of heat enclosure problem. For overall economy and efficiency, specify Bigelow-Liptak enclosures for boiler settings in power plants; oil stills and vessel linings in oil refineries; for all kinds of driers and kilns and metallurgical furnaces. Write today.

BIGELOW LIPTAK Corporation

BIGELOW-LIPTAK

Unit-Suspended Walls & Arches

SUBSIDIARY OF A. P. GREEN FIRE BRICK CO.

CURTIS BUILDING • DETROIT 2, MICHIGAN

IN CANADA

BIGELOW-LIPTAK OF CANADA, LTD., TORONTO, ONTARIO

DETROIT · CHICAGO · NEW YORK · SEATTLE · SALT LAKE CITY · PHILADELPHIA · MINNEAPOLIS · CLEVELAND · CINCINNATI · PITTSBURGH · SAN FRANCISCO
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STOP, LOOK AND READ HOW EASILY **LVD Flex-a-power**

CUTS INSTALLATION COST

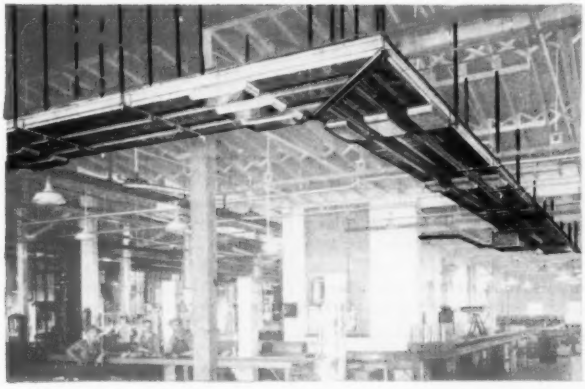
KEEPS MAINTENANCE LOW

GIVES MAXIMUM BUSWAY FLEXIBILITY

Because Trumbull LVD FLEX-A-POWER® is made in pre-fabricated units, you save money with this system these three ways.

The units are easily and quickly put together . . . no special engineering skill is required for installation. This means that many expensive time and labor costs are eliminated for a *lower "installed cost."*

Not only is LVD pre-fabricated, but it is pre-engineered so that you can predetermine electrical performance before actual installation. This advantage is an important factor in minimizing voltage drop and in keeping machine efficiency high.



LONG-LIVED MATERIALS —

Another advantage — LVD FLEX-A-POWER materials do not deteriorate even under the most severe operating conditions, thus assuring years of satisfactory service *without costly maintenance repairs.*

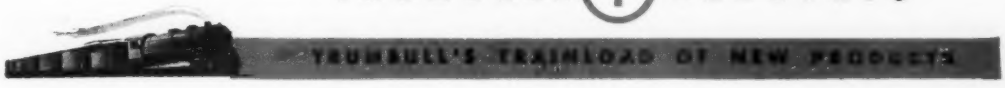
ADAPTABLE, "TAKE-APARTABLE" —

LVD FLEX-A-POWER is readily adaptable to any power distribution problem you may have. Fast to install, its convenient "take-apart-ability" allows you to relocate your LVD system without replacing a single part!

Learn more about the many advantages of LVD. Write for Circular TEC 152 today. THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Conn.

Men Who Observe the Best Electrical Practice Make It a Practice to Use

TRUMBULL (T) ELECTRIC

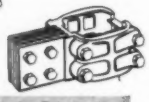


MAKE CONNECTIONS THREE WAYS

...with Chase Square Bus Conductors!

1 CLAMP TYPE JOINTS

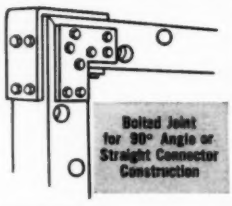
Straight Connector Tube to Tube



Tee Connector Tube to Bar

Tee Connector Tube to Tube

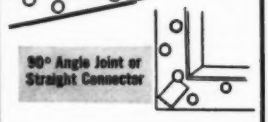
2 BOLTED JOINTS



Bolted Joint for 90° Angle or Straight Connector Construction

3 BRAZED JOINTS

Tee Joint



90° Angle Joint or Straight Connector

THREE different types of connections can be used on installations of Chase Square Copper Bus Conductors—clamping, bolting or brazing. In addition, the four flat sides permit adequate and uniform pressure to be exerted between the large contact surfaces, resulting in firm, secure joints.

For information on other advantages of Chase Square Copper Bus Conductors, ventilated and unventilated, send for our new illustrated booklet to Dept. PO59.

Chase

the Nation's Headquarters for
BRASS & COPPER

WATERBURY 20 CONNECTICUT — SUBSIDIARY OF KENNECOTT COPPER CORPORATION

THIS IS THE CHASE NETWORK . . . *handiest way to buy brass*

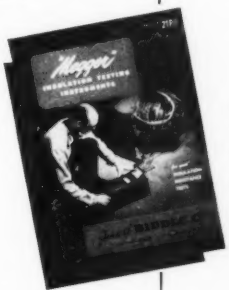
ALBANY† ATLANTA BALTIMORE BOSTON CHICAGO CINCINNATI CLEVELAND DALLAS DETROIT HOUSTON† INDIANAPOLIS KANSAS CITY, MO. LOS ANGELES MILWAUKEE MINNEAPOLIS NEWARK NEW ORLEANS NEW YORK PHILADELPHIA PITTSBURGH PROVIDENCE ROCHESTER† ST. LOUIS SAN FRANCISCO SEATTLE WATERBURY †Sales Offices Only

HERE'S what the chief engineer of a large sugar refinery—using its own generators and over a thousand motors from ¼ to 150 hp—has to say about "Megger"* Insulation Testers:

"Every Saturday . . . the Wizard (Chief Electrician) applied our 'Megger' Tester to all of our important generating equipment. Usually nothing happens . . . Then one day the 'Megger' test indicates a leak . . . Like the surgeon's X-ray the 'Megger' test detects the condition, and a failure is forestalled. With our insulation resistance records we further watch any progressive weakening of the 'arteries' and have warning that permits us to make repairs at convenient times . . . A maintenance gang without a 'Megger' tester would be like a surgeon without an X-ray machine."

Are you getting the benefit of this kind of insurance protection for the important electrical equipment in your plant? "Megger" Insulation Testers are available in various types (including the unique "Bridge-Meg" instrument here illustrated) with ratings up to 10,000 megohms and 2500 volts d-c. Write today for illustrated Bulletin 21P7-P.

* *The photograph and the quotation in this advertisement are used by courtesy of the Pennsylvania Sugar Company of Philadelphia, and Dan Gutleben, who until recently was Chief Electrical Engineer.*



REG. U. S. PAT. OFF.

JAMES G. BIDDLE CO.
Electrical & Scientific Instruments
1316 ARCH STREET, PHILADELPHIA 7, PA.

Common troubles licked here!

HERE is a Darling Gate Valve designed to relieve you of the most common valve troubles. There are a number of contributing features, but let's take only two . . .

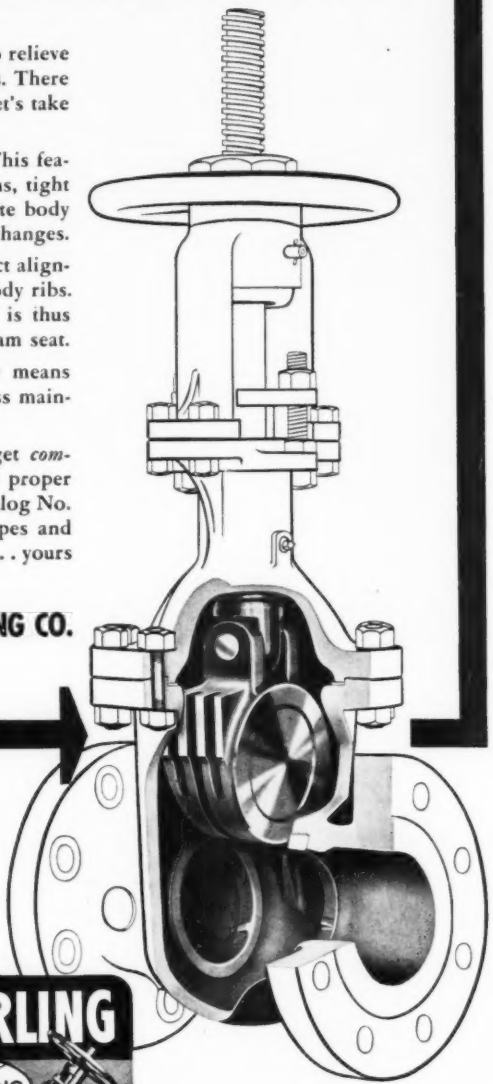
First, note the center slot in the wedge. This feature allows compression of the wedge. Thus, tight closing and easy opening are assured despite body expansion or contraction due to temperature changes.

Secondly, wedge travel is guided for perfect alignment by *double* wedge grooves and *twin* body ribs. Canting of wedge caused by line pressure is thus eliminated, preventing damage to downstream seat.

Here's a combination that just naturally means more reliable operation . . . less trouble, less maintenance, less cost!

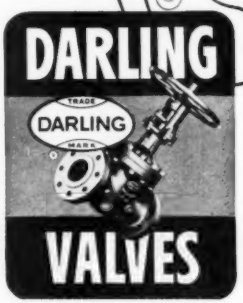
Outline your service requirements and get *complete* information on Darling Valves of the proper type. Or, send for the 300-page Darling Catalog No. 17M. It describes Darling Valves of all types and sizes . . . and is full of data of general value . . . yours for the asking.

DARLING VALVE & MANUFACTURING CO.
WILLIAMSPORT 8, PA.

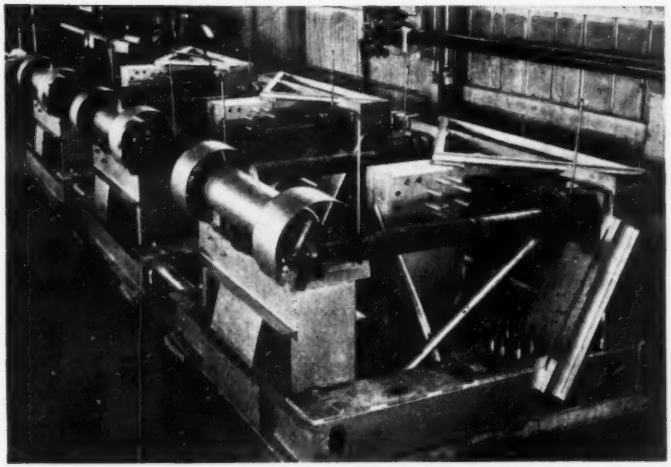


Darling
Slotted Wedge
Cast steel gate valves

Darling Gate Valves, noted for outstanding quality, strength and precision, are made in a wide range of sizes, types and constructions for all kinds of normal and unusual service . . . and for pressures up to 1500 pounds. In addition to the *Slotted* wedge types, there are solid wedge taper seat valves and the famous Darling Fully Revolving Double Disc Parallel Seat Gate Valves for virtually any service.



THE VALVE MARK OF QUALITY... WATCH FOR IT



Strength through Design in Tube-Turn welding flanges

Taking the measure of piping fatigue

PIPE lines are *live, dynamic* members of a piping system. They *breathe* with changes in temperature and pressure. And the danger of fatigue failure from pressure shock, thermal shock, and cyclic conditions is ever-present.

More precise information was needed on this subject. So, Tube Turns research engineers set out to get the answers. For the purpose, they designed and built a unique cyclic testing machine to handle full-size piping assemblies under a wide range of temperature, pressure, and corrosive conditions. And on this torture rack they subjected flanged assemblies to reverse bending tests carried on to ultimate failure. Information revealed forms the basis of new designs for greater strength in Tube-Turn welding flanges.

Other piping assemblies, too—welding elbows, mitre bends, manufactured and fabricated tees, pipe bends—have been subjected to punishment more severe than any they would probably face in normal service.

And this perpetual search for greater strength through better design has paid off in the form of realistic, non-theoretical facts providing a sound basis for Tube Turns' manufacturing policies—facts important to anyone interested in getting his money's worth in long life from piping installations.

Tube Turns' research and development organization, finest in the welding fittings industry, is constantly striving for the improvement of present products, the development of new ones. Notable among their recent achievements have been the design of a new type welding tee and the development of aluminum welding flanges.

Ask to be put on the mailing list for Tube Turns' technical periodical, *Piping Engineering*. Paper 6.01, for instance, deals extensively with standard steel flanges. Others give you research findings and additional working information pertaining to piping not generally available in convenient form.

TUBE-TURN

tt

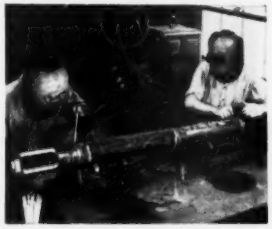
WELDING FITTINGS AND FLANGES

TUBE TURNS, INC.

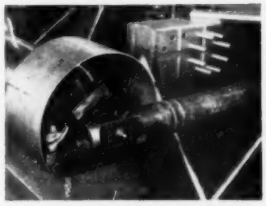
236 East Broadway, Dept. H, Louisville 1, Kentucky

District Offices at New York, Philadelphia, Pittsburgh, Chicago, Houston, Tulsa, San Francisco, Los Angeles

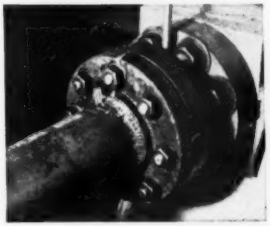
TYPICAL FLANGE ASSEMBLY TESTS



Assemblies were of 4-inch nominal size with 300 pound forged steel flanges and standard weight pipe.



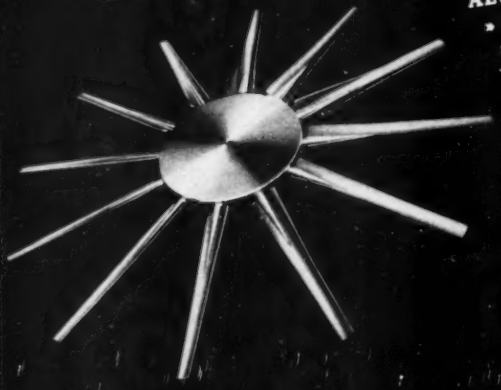
Eccentric crank arm produces up-and-down movement which creates a cyclic bending moment on flange or fitting at opposite end of assembly.



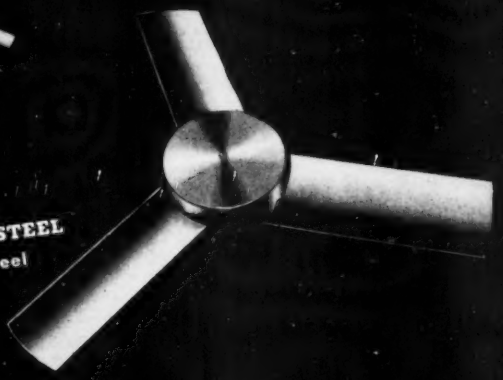
Water spurts from crack in test specimen. Almost invariably, failure occurred in the pipe adjacent to the flange.

Aluminum welding flanges . . . another Tube Turns first! Available in a wide range of types and sizes.

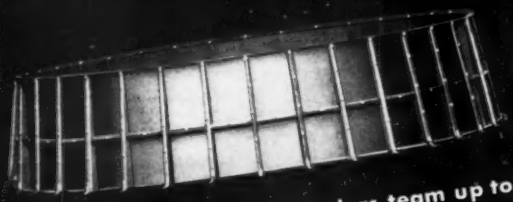
NEW Marley FANS
For Cooling Towers and DriCooler* Do The Job Better . . . Longer



ALUMINUM
- » Multibladed » Balanced
- » Unusually quiet and smooth operation
- » High tensile cast aluminum alloy
- » Adjustable pitch » Air foil section
- » Twisted and tapered blades



STAINLESS STEEL
- » All stainless steel
- » Adjustable pitch » Balanced
- » Air foil section
- » Quiet and smooth operation



FAN CYLINDER
- » Unusually rugged » All bolted
- » Flared throat
- » Non-corrosive

Marley Fans and Fan Cylinders team up to do the job better . . . longer! These fans are designed and manufactured by The Marley Company especially and exclusively for water cooling applications.

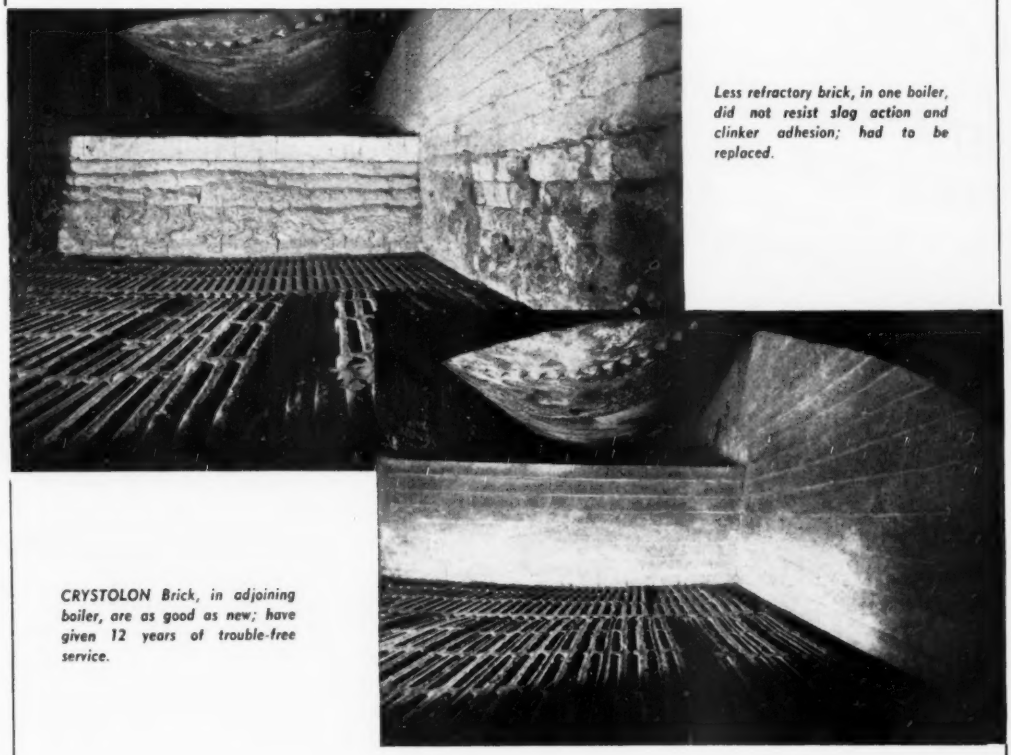
Your new MARLEY Water Cooling Tower or "DriCooler"* will have this equipment, but you can improve your present water cooling tower, right now, regardless of size or make with these new MARLEY FANS.

*DriCooler is the exclusive trade-mark of The Marley Company, Inc., and designates its finned tube dry surface cooling equipment.

MARLEY

THE MARLEY COMPANY, INC. • KANSAS CITY 15, KANSAS

Comparisons prove that for economical service the *qualities* of CRYSTOLON* Brick are *important*



Less refractory brick, in one boiler, did not resist slag action and clinker adhesion; had to be replaced.

CRYSTOLON Brick, in adjoining boiler, are as good as new; have given 12 years of trouble-free service.

Densely made of silicon carbide, CRYSTOLON Brick offer four oustanding features: (1) resistance to slag action, (2) resistance to clinker adhesion, (3) resistance to high temperatures, (4) resistance to abrasion. Whether in handfired jobs illustrated above where heat is important or in stoker installations where power may be the objective, CRYSTOLON Brick give long, trouble-free service. They demonstrate their reliability best where conditions are most severe.

NORTON®

NORTON COMPANY
WORCESTER 6, MASSACHUSETTS

*Trade-mark Reg. U.S. Pat. Off.

GET A GOOD SHARE OF SAVINGS FROM YOUR BOILER ROOM . . . .

TO OFFSET *Higher Production Costs*

CASH STANDARD AUTOMATIC COMBUSTION CONTROL SYSTEMS

Install a CASH STANDARD Automatic Combustion Control System and you get the following results. The rate of fuel feed is adjusted exactly to the load requirements at all times—a correct proportion of carbon from the fuel and oxygen from the air is maintained—you avoid heat waste thru the stack because of proper operation of the stack damper.

Your present boiler becomes a better producer of steam. Your fuels work with peak effectiveness so that you use less fuel for the steam you require. Your maintenance needs are greatly lessened. You get continuous, dependable, accurate automatic control at all times.

When you have CASH STANDARD Correct Fuel Feed . . . Fuel-Air Ratio and Over-Fire Draft, you make savings that help level off high production costs.

BOOKLET No. 300 gives details on steam plant economy

This booklet describes and shows various installations of CASH STANDARD units on coal, oil, and gas burning boilers. Each unit is pictured and explained in detail. Send for your copy and see why you can effectively use this CASH STANDARD Automatic Combustion Control System to save money.

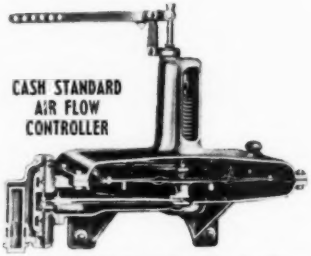
SYSTEMS FOR ONE OR A BATTERY OF BOILERS

● **CASH STANDARD** units are available in a number of variations. Combinations can be made to give you complete automatic control with all of its benefits. Size of your boiler or type makes no difference.

CASH STANDARD FUEL FEED CONTROLLER . . .

Automatically Regulates Fuel Feed

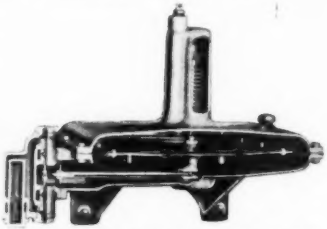
This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion — hence, money saving.



CASH STANDARD AIR FLOW CONTROLLER

Meters the Air Needed for Combustion

This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.



CASH STANDARD FURNACE DRAFT CONTROLLER

Maintains a Constant Draft in the Combustion Chamber

This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.

A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD CONTROLS . . VALVES

LOWER OPERATING COSTS... ADEQUATE STORAGE... CLEANER OPERATION...

in your plant...

with FAIRFIELD coal and ash handling equipment

Bucket elevator—exterior view of large coal handling plant showing bucket elevator.

Interior view showing bunker, chutes and scales.

Chutes from internal bunker to pulverizers. Note clean firing aisle.

Analyze your power plant expenditures. Do they show handling charges out of line for the year's operation? You can cut costs materially by replacing or modernizing your coal and ash handling system. Coal and ash handling systems designed and built by Fairfield represent the latest in modern handling methods. They are labor-saving, cost-saving and will introduce a cleanliness and efficiency never before known in your boiler house. A Fairfield engineer, with years of practical experience, will gladly talk over your handling problems with you. Write today for his services or a catalog showing new Fairfield equipment and installations. No obligation, of course.

FAIRFIELD DESIGNS AND BUILDS FOR YOUR PLANT: complete coal and ash handling systems, with silo or bunker storage; bucket elevators; skip hoists; conveyors of all types; crushers; feeders; weigh larries; track hoppers, etc.—also complete glass batch plants and other bulk material handling equipment.

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Builders of Dependable Coal and Ash Handling Equipment

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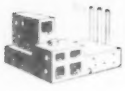
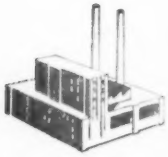
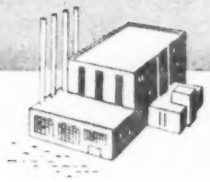
Corrugated Tangents
—for Maximum Flexibility where space is limited...

The flexibility of a P.P.&E. Corrugated Tangent is much greater than a straight pipe of equal length, diameter, and wall thickness. This inherent flexibility minimizes stresses resulting from thermal expansion, and reduces end reaction against equipment.

Corrugated tangents can be prefabricated by us in any practical design. Used alone, or together with P.P.&E. Creased Bends, they make practicable the installation of a complex system where space is at a premium.







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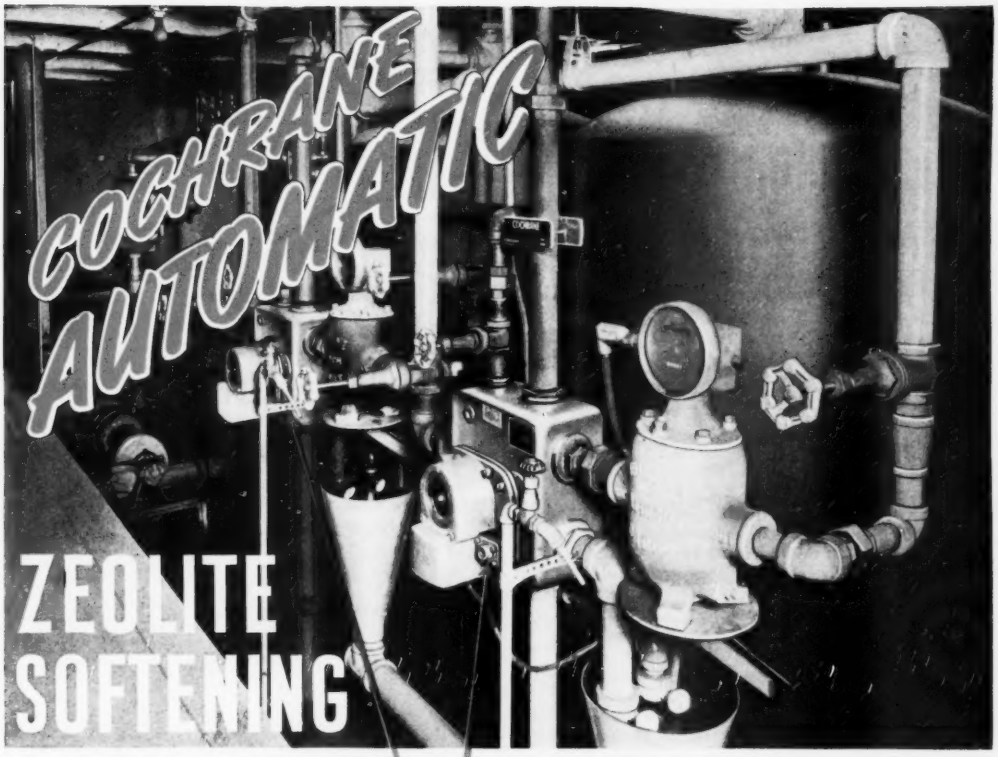
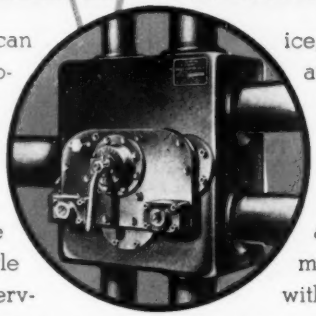


with the COCHRANE HYDROMATIC VALVE



ZEOLITE water softening can now be accomplished automatically by means of the new Cochrane Hydromatic Valve equipped for automatic operation. This exclusive patented feature of all Cochrane Zeolite Softeners combines, in a single unit, a 4 position valve for service, back-wash, brine, and rinse, and, in addition, has 2 standby positions. Cochrane's standing in the field of water conditioning is your assurance of satisfactory softening; the ease and certainty of the Hydromatic Valve insure operation with the minimum of attention.

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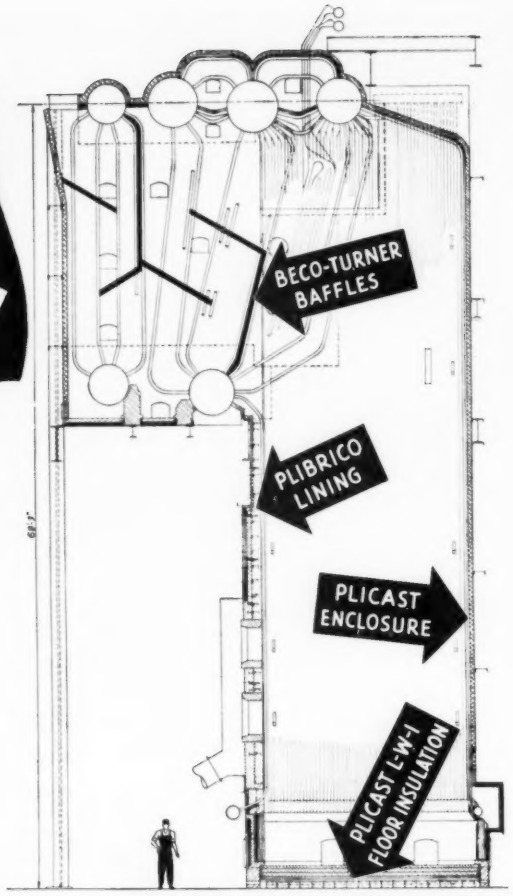
They don't come too big for PLIBRICO!



If you stood in the middle of one of the 31 x 17 ft. furnaces shown in the accompanying print, and looked up at the C-E boiler which towers 68 ft. above the floor line, you would agree that steam generators don't come too big for Plibrico construction.

Three C-E boilers like this, fired with blast furnace gas and delivering 250,000 lbs. of steam per hr., were recently erected at the Inland Steel Co., East Chicago, Ind. The furnace enclosures for these boilers were built by Plibrico, and down to the last detail they are a compelling demonstration of Plibrico utility and flexibility.

The enclosure on three sides of the furnace (having tangent-tube water walls) is our tube-suspended wall construction consisting of Plicast castable refractory, insulation, and welded steel casing — a completely air-tight enclosure permitting precise control of combustion. The burner wall (the only wall having spaced tubes) is lined with Plibrico Jointless Firebrick backing up the tubes. This wall, 33 ft. high, is not tube supported, but sectionally supported from the brickwork. Plicast L-W-I lightweight, insulating castable is used in the furnace floor to protect the foundation. Beco-Turner baffles, engineered to give maximum heat transfer, are the finishing touch to a boiler setting masterpiece.

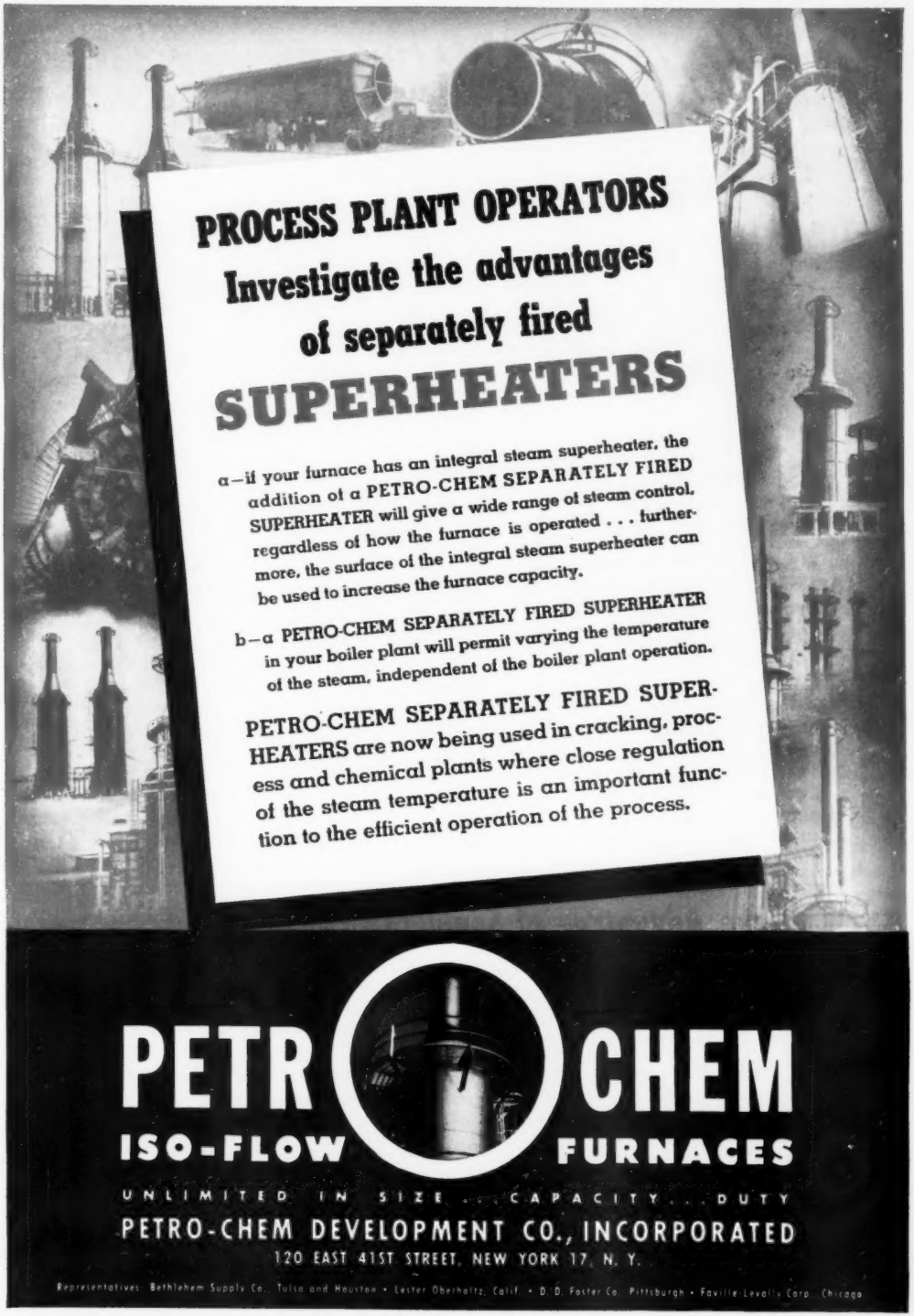
ABOVE: Longitudinal section through Inland boiler.

RIGHT: Burner wall with Plibrico Jointless Firebrick backing up spaced tubes.

While you were looking at this demonstration of Plibrico versatility and flexibility, you would realize that Plibrico refractories, engineering, and construction methods are also the answer for any refractory need of any boiler down to the smallest. So whatever your requirements, from a complete setting to a simple patch, call upon your local Plibrico Sales & Service organization. Their engineering recommendations and crew of expert furnace builders are at your service.

PLIBRICO JOINTLESS FIREBRICK CO., 1818 Kingsbury St., (Dept. E) Chicago 14, Ill.

PLIBRICO *Furnace* ENCLOSURES


PROCESS PLANT OPERATORS
Investigate the advantages
of separately fired
SUPERHEATERS
a—if your furnace has an integral steam superheater, the addition of a PETRO-CHEM SEPARATELY FIRED SUPERHEATER will give a wide range of steam control, regardless of how the furnace is operated . . . furthermore, the surface of the integral steam superheater can be used to increase the furnace capacity.
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PETRO-CHEM SEPARATELY FIRED SUPERHEATERS are now being used in cracking, process and chemical plants where close regulation of the steam temperature is an important function to the efficient operation of the process.
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2 Ways to Increase Boiler Room Efficiency

GRAHAM

A Thrifty Fuel Since 1903

COAL

BROWDER

KENTUCKY COAL

1. The GRAHAM trade name has been recognized among industrial buyers for half a century as the fuel that produces maximum power at minimum cost. Year after year it has maintained a steadfast reputation for efficiency and economy and unvarying performance.

GRAHAM has been produced in Western Kentucky continuously since 1903. Through the years it has held a position among buyers of industrial coal as a low cost, dependable fuel—and since the reserves of GRAHAM Coal are tremendous, plant engineers are assured of an ample supply for years to come.

2. BROWDER is another Western Kentucky coal that has for a half century served as a dependable guide to boiler room efficiency and economy. Industrial users know Browder Coal delivers on-the-job results that count on the profit side of the ledger.

BROWDER'S steady production and tremendous reserves assure industrial plant operators immediate shipment and ample supply of this low cost, dependable fuel for many, many years ahead. Give BROWDER a test in your plant—the results will more than likely show you the way to lower steam costs.

Take Advantage of Southern's Engineering Service

Our staff of skilled combustion engineers are always available for boiler room counsel right in your plant. They will bring you the benefit of Southern's 53 years of experience in the coal business. They will gladly conduct a survey of your plant—and show you how either GRAHAM Coal or BROWDER Coal can do an efficient job for you at low cost. Write or telephone our nearest office.

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Southern Coal Company, Inc.

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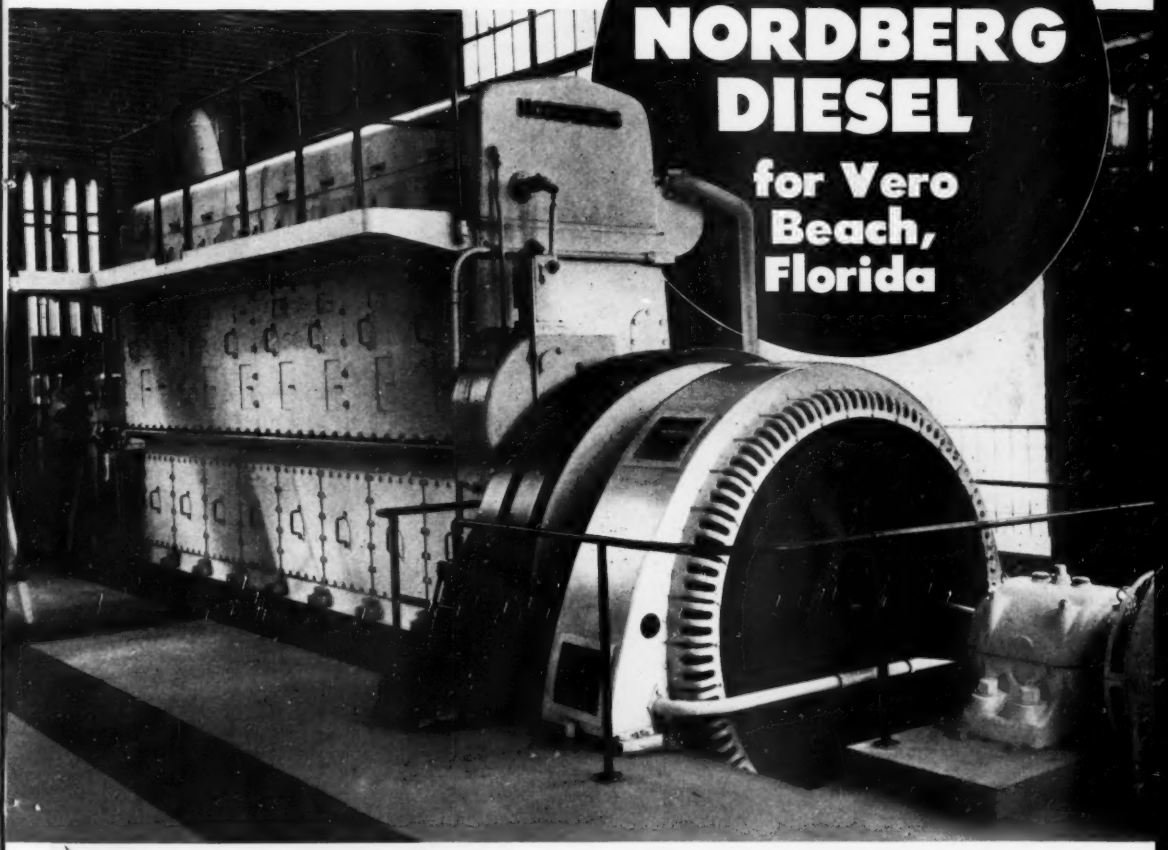
(GB-1)

1630 H.P. NORDBERG DIESEL for Vero Beach, Florida



Directly above is an exterior view of the municipal power plant at Vero Beach, Florida.

• • • •

In addition to the 1630 H.P. engine illustrated, Nordberg offers a complete line of stationary power units, in two and four-cycle types, from 10 to 8500 H.P., including Diesel, Gas Diesel and Duafuel models.

Residents of Vero Beach can well be proud of their new spic and span Nordberg Diesel, recently installed to provide dependable electric service for this resort area on Florida's east coast. This new Nordberg is an 8-cylinder, 16″ x 22″ four-cycle supercharged unit driving a 1150 K.W. generator.

It is interesting to note that even though the view shown above was made while the engine was running, there is no camera distortion...added proof that Nordberg Diesels provide smooth, vibrationless power.

If you are considering new or increased power facilities, investigate the outstanding features offered in the complete Nordberg line of Diesel and gas burning engines.

NORDBERG MFG. CO.
Milwaukee 7, Wis.

P549

NORDBERG
DIESEL ENGINES

G-R MULTIWHIRL COOLER

has multi-advantages for cooling...

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Circulating Water
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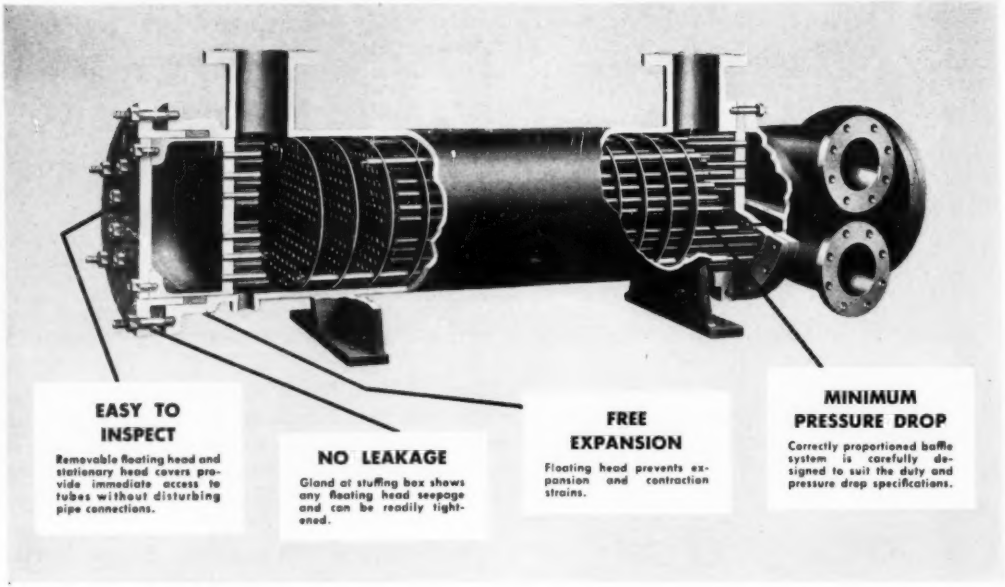

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Removable floating head and stationary head covers provide immediate access to tubes without disturbing pipe connections.

NO LEAKAGE

Gland at stuffing box shows any floating head seepage and can be readily tightened.

FREE EXPANSION

Floating head prevents expansion and contraction strains.

MINIMUM PRESSURE DROP

Correctly proportioned baffle system is carefully designed to suit the duty and pressure drop specifications.

YEAR AFTER YEAR, you'll benefit from these important design features of the G-R Multiwhirl Cooler. These sturdily-built units stay on the job, providing effective heat transfer with minimum maintenance. Thousands of installations have already proved the multi-advantages of the G-R Multiwhirl Cooler.

If your plant operations require the cooling of liquids, be sure to get the "inside story" on the G-R Multiwhirl Cooler. Bulletin 710 fully describes these units. Write for your copy today.

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PIONEERS IN HEAT TRANSFER APPARATUS

ZERO HARDNESS

ZERO ALKALINITY*

with

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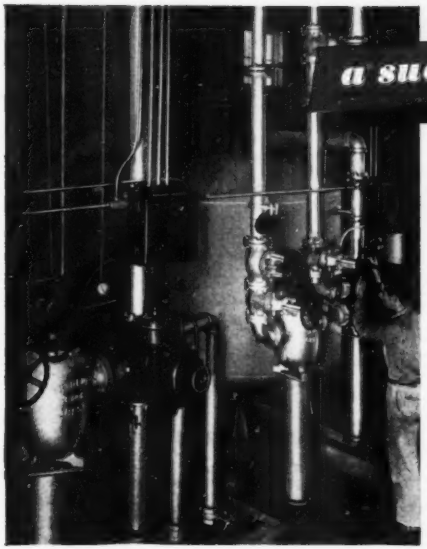

a success for over 10 years

Over ten years of successful performance have proven the efficiency of Zeo-Karb** in removing sodium bicarbonate from solution, softening water and simultaneously reducing alkalinity to any desired level.

Zeo-Karb also removes sodium, magnesium, calcium, iron, aluminum and manganese from water supplies. Zeo-Karb, with its unlimited tolerance for acid water, will withstand the attack of acid indefinitely. Choose the *proven* water treatment method —use Zeo-Karb made only by Permutit. For full details contact The Permutit Company, Dept. P-5, 330 West 42nd St., New York 18, N. Y. or The Permutit Company of Canada, Ltd., Montreal.

* or any desired value

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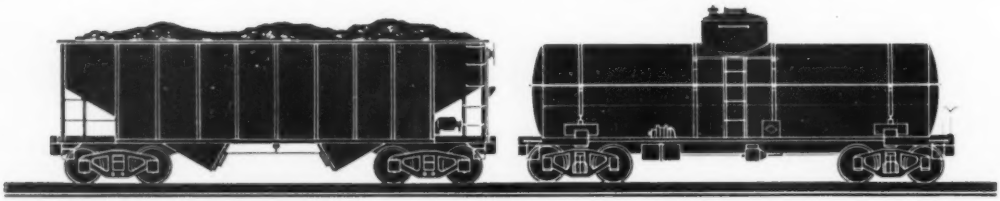
FOR OVER 35 YEARS
WATER CONDITIONING HEADQUARTERS

Permutit

NO MATTER HOW FUEL COSTS FLUCTUATE



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ENCO

OIL BURNERS WITH COAL FIRED UNITS

YOU CAN ALWAYS TAKE ADVANTAGE of the best market price of fuel when your power plant is equipped with Enco Oil Burners in combination with coal burning units. You can readily change from coal to oil — and back to coal. Comparative BTU costs and fuel availability are the only governing factors.

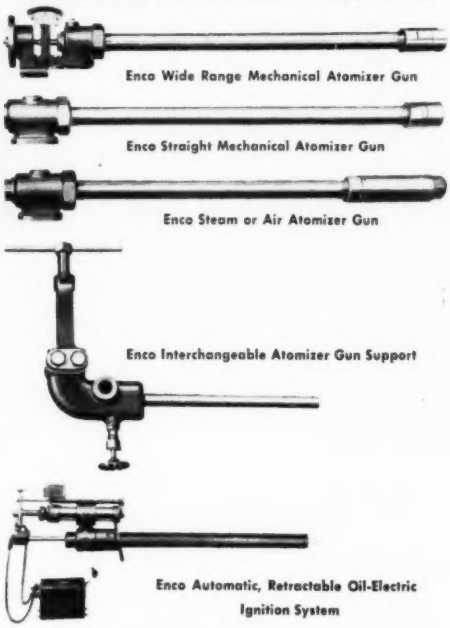
With Pulverized Coal Burners, you can use either Enco Mechanical or Steam Atomizers for ignition and entire load range because both oil and coal are finely divided fuels that burn in suspension. Bulletin OB-PC contains complete details on use of Enco Oil Burners with Pulverized Coal. A copy will be sent on request.

With Stoker or Hand Fired Units, this same combination can be made for partial or full loads, either for temporary or permanent application. Complete information on installations of this type will be sent on request.

BULLETIN OB-PC GIVES FULL INFORMATION ON THESE ENCO UNITS

★ ★ ★

ENCO INTERCHANGEABLE FUEL OIL ATOMIZERS



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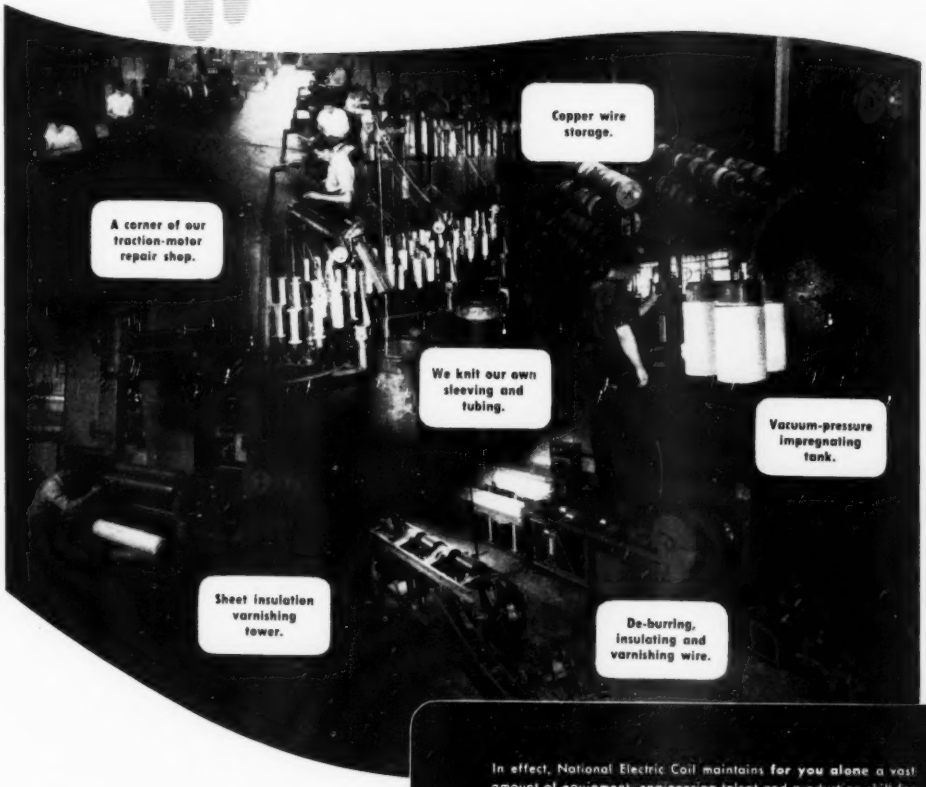
these motor-generator maintenance facilities are yours!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We knit our own sleeving and tubing.
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In effect, National Electric Coil maintains **for you alone** a vast amount of equipment, engineering talent and production skill for the repair or redesign of your rotating electrical machines. It's maintained to give you the quick action and the skill you would expect if you could afford to have it in your own shop. When motor or generator trouble crops up, let National handle it. If trouble persists, let National discover and overcome the cause. If needs change, let National redesign to meet the changed conditions. Use your National shop.

Wherever you are our nearby Field Engineer is available

NATIONAL ELECTRIC COIL COMPANY

COLUMBUS 16, OHIO, U. S. A.

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Tank Gauge

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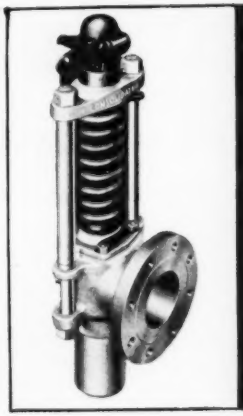

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CONSOLIDATED
Maxiflow
SAFETY VALVE

It solves the problem!

The CONSOLIDATED Maxiflow was designed and engineered to meet operating requirements of high pressure, high temperature steam generating equipment. A new addition to the CONSOLIDATED Safety Valve line, the Maxiflow answers the need for a valve with greater discharge capacity, shorter blowdown and other special characteristics not found in conventional safety valves.

Blowdown, adjustable to a low of 1%, is achieved by advantages no other safety valve possesses.

The CONSOLIDATED Thermodisc seat design —incorporated in the Maxiflow—guarantees a degree of tightness not found in any other safety valve.

Function, design, materials, weight, safety and space—all have been major considerations of creative engineering and unsurpassed workmanship in the development of the CONSOLIDATED Maxiflow Safety Valve.

We will be glad to send you a detailed bulletin concerning the Maxiflow.

MANNING MAXWELL & MOORE INC. TRADE MARK

CONSOLIDATED SAFETY VALVES

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A Product of

MANNING, MAXWELL & MOORE, INC.
BRIDGEPORT 2, CONNECTICUT

Makers of Consolidated Safety and Relief Valves, 'American' Industrial Instruments, Hancock Valves, Ashcroft Gauges. Builders of 'Shaw-Box' Cranes, 'Budgit' and 'Load Lifter' Hoists, and other lifting specialties.

NAVCO "Universal" PIPE SUPPORTS

Vertical adjustment up to 2½ inches can be made.

Support may be turned to any angle of 360°.

Will take care of 8 inches of travel.

Features

Universal Pipe Supports hold the pipe down as well as up. They prevent pipe from getting out of alignment, which is usual when Roller Supports are used.

They permit control of expansion movement and insure the desired free action of Slip Expansion Joints so essential in tunnel and duct work.

Expansion movement of pipe will not disturb the insulation.

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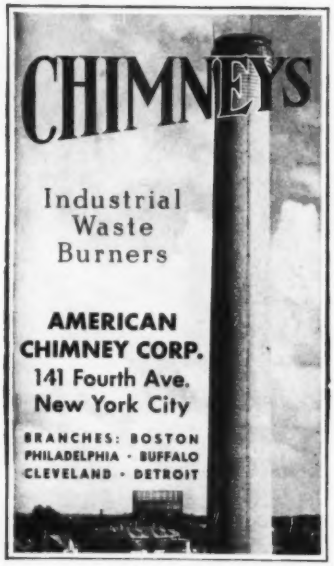

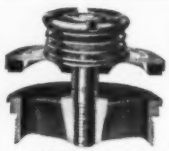

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● They increase efficiency, capacity, economy—decrease slippage, leakage, fuel consumption—will not sink in seat ports, warp, break, curl, or ride seat bridges. For hot or cold water service . . . thoroughly dependable.
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ERNST Liquid Level Gages
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SINCE 1908

● The valve with the renewable feature restores old pumps to original efficiency. Constant contact is maintained over the full bearing surface no matter in what position the valve rotates because of the exclusive HILL design. Efficient, durable, economical, accurate.

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EISLER TRANSFORMERS are *manufactured strictly to Standards of the N.E.M.A., A.S.A., and A.I.E.E.*

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This year he's on the job in June!

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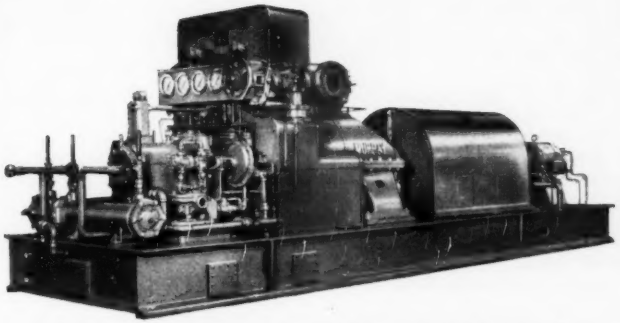
POWER

A McGRAW-HILL PUBLICATION
330 W. 42nd St., New York 18, N. Y.

MURRAY
TYPE D TURBO-GENERATOR



Murray Type D turbo-generators are built in a capacity range from 500-3000 KW. Turbines are either direct-connected to 2-pole generators or operate through reduction gears connected to 6-pole generators at 1200 RPM. Direct current and 25 cycle machines are also available. This type machine is regularly furnished in the above capacity range either condensing or non-condensing and may be of the automatic extraction type or for high back pressure. Units may be mounted either on soleplates or on a fabricated steel base.

This type turbo-generator is designed to operate on steam conditions up to 600#, 750° F. TT. Auxiliary equipment normally includes combined trip throttle valve, complete pressure lubrication system including oil tank, oil filter, coolers, and automatic turbine-driven auxiliary oil pump. Gauge board with gauges, vibrating reed tachometer and necessary thermometers are also furnished.

The above photograph shows a machine of this type rated at 1000 KW. Two duplicate machines are installed in our Nation's Capitol.

Murray turbo-generators have long been noted for their rugged construction, operating economy and long life with a minimum of maintenance.

WRITE TODAY FOR FULL DETAILS

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA

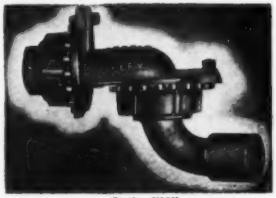
BUILDERS OF STEAM POWER EQUIPMENT
FOR THREE QUARTERS OF A CENTURY

FLEXO JOINTS

ASSURE SAFE, UNRESTRICTED FLOW

. . . THROUGH ALL MOVING PIPE LINES

Wherever a flexible or swing joint is needed—Flexo Joints are ready to convey high or low pressures safely and dependably. Constructed of just four simple parts for less wear, longer service, Flexo Joints offer these outstanding operating advantages:



Style "H"

- Complete 360° movement, with unrestricted flow in all positions.
- Maintain even pressures and corresponding temperatures.
- Dependable, safe.
- No springs, no small parts—no ground surfaces to wear.

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INSTRUMENT CURRENT TRANSFORMERS

- *"DONUT"*
- *RECTANGULAR*
- *COMPENSATED "DONUT"*
- *LARGE RECTANGULAR*

Model 310 "Donut" available in all standard ranges, having a 2 VA capacity for use at frequencies from 25 to 133 cycles. Thoroughly insulated for 4500 volts. Normally supplied with 2' secondary leads. Spotted for phasing. Multiple ranges also available.

Model 311 Rectangular, designed for use on bus bars $\frac{1}{4}$"x1$\frac{1}{2}$". Similar to Model 310 as to leads, insulation, capacity, and phase markings. Also available in all standard ranges.

Model 313 Compensated "Donut" 5 VA capacity. Like Model 310 of inserted primary type. Compensated for phase-angle and ratio error. Can be used to increase current ranges of wattmeters, watt hours meters, and other instuments requiring compensated transformers.

Model 314 Large Rectangular, For higher ratios, $\frac{1000}{5}$ to $\frac{4000}{5}$ amps. 5 VA capacity. For use on bus bars 1" x 4".

Ruggedly built. Reliable. Special ratios to order.

Write us on your instrument current transformer problems.

Send for Bulletins with full engineering data and drawings.

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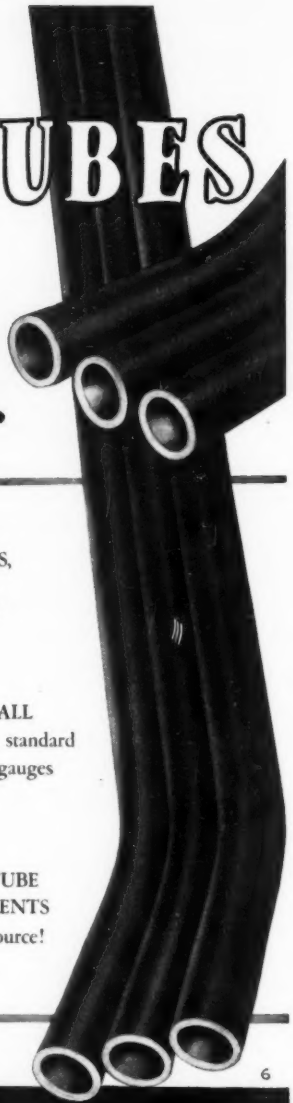

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TUBES OF ALL SIZES — in standard and extra gauges

ANY TYPE TUBE REPLACEMENTS from one source!

6

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NEW ADVERTISEMENTS received by May 5th will appear in the June issue, subject to limitation of space available.

MECHANICAL ENGINEERS
For Positions of
Project and Senior Engineers
Steam Power Plant and/or Gas Plant Experience Preferred—Ideal Community—Close to Metropolitan Areas. Write to
MECHANICAL ENGINEER
PENNSYLVANIA POWER & LIGHT CO.
ALLENTOWN, PA.

WANTED
GRADUATE MECHANICAL ENGINEERS
For Power station engineering and design. Location, Western Pennsylvania. Qualifications, experience record, and picture should be submitted with letter of application.
P-8638, POWER
330 West 42 St., New York 18, N. Y.

PUMP SALES ENGINEERS
Manufacturer of Centrifugal Pumps located in Midwestern City of 20,000 population desires two experienced pump sales engineers to work directly under Sales Manager handling factory quotations to domestic and foreign distributors. Our employees have been informed of this advertisement.
P-8674, POWER
520 N. Michigan Ave., Chicago 11, Ill.

REPLIES (Box No.):
Address to office nearest you
NEW YORK: 330 W. 42nd St. (18)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

WANTED: MANAGER for $6,000,000.00 Michigan Power Generation and Transmission Cooperative System, financed by the Rural Electrification Administration. Engineering or utility experience desirable but executive competence primary requisite. Write for application blanks, Wolverine Electric Cooperative, c/o Earl C. Murley, Newaygo, Michigan.

ENGINEERS: LARGE college offers $3000, approx. half time teaching-studying. All ranks univ. positions, experienced $4500-$6400 nine months. Give phone, photo, qualifications. Cline Teachers Agency, East Lansing, Mich.

SELLING OPPORTUNTY OFFERED

MANUFACTURERS REPRESENTATIVES wanted by an Ohio Industrial Stoker Manufacture. Proven product. Has been on the market a number of years. Write for further information. RW-8086, Power.

EMPLOYMENT SERVICES

SALARIED PERSONNEL $3,000-$25,000. This confidential service established 1927, is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. G, 241 Orange St., New Haven, Conn.

Don't forget the
BOX NUMBER
When answering the classified advertisements in this magazine, don't forget to put the box number on your envelope. It's our only means of identifying the advertisement you are answering.

PROJECT ENGINEER POSITION OPEN

A project engineer position is open to person experienced in design and operation of modern steam power plants. Experience in central station for public utilities desirable. Location in Midwest. Our own employees notified of this opening. When replying state education and experience background.

Address
P-8562, POWER
520 N. MICHIGAN AVE. CHICAGO 11, ILL.

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SALARIED POSITIONS $3,500-$35,000. If you are considering a new connection communicate with the undersigned. We offer the original personal employment service (39 years recognized standing and reputation). The procedure, of highest ethical standards, is individualized to your personal requirements and develops overtures without initiative on your part. Your identity covered and present position protected. Send only name and address for details. R. W. Bixby, Inc., 270 Dun Bldg., Buffalo 2, N. Y.

POSITIONS WANTED

CHIEF ENGINEER. Age 35, Experience 17 years. Power Plant engineering and construction. Steam; refrigeration; electrical; hydraulic; some marine work; instrument; etc. PW-7872, Power.

YOUNG STEAM Engineer, sound technical and practical background. Licensed Ohio, Maryland. Supervisory experience as Asst. Chief Engineer and Boiler House Chief. Desires opening with future. 29 years old, married, Navy veteran. PW-8518, Power.

POWER PLANT Supervisor, technical school graduate, former marine engineer, refrigeration and high pressure power plant experience. PW-8410, Power.

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I am a special representative for Dampney and Apexior in N.Y.C. I can handle one more good line. W. T. Quimby, 142 E. 71 St., N.Y.C.

INCREASE SALES, cut costs. Sales engineers with offices New York City and Washington D.C. desire account for engines, turbines, pumps, compressors, or similar line. Call regularly on consulting engineers, industrials, shipyards, municipalities, federal agencies, etc. References. RA-8659, Power.

WANTED

ANYTHING within reason that is wanted in the field served by Power can be quickly located through bringing it to the attention of thousands of men whose interest is assured because this is the business paper they read.

WANTED
SALES MANAGER FOR LARGE DIESEL GENERATORS
Appointment available for competent engineer to serve as sales manager for diesel division of established, well-known organization on West coast. Man should have versatility and ability to organize sales agencies. Also, good knowledge of public utility and industrial power fields. Permanent position, good salary. *Write*
SW-8607, POWER
68 Post St., San Francisco 4, Calif.

WANTED
ESTABLISHED ENGINEERING FIRMS — SALES AGENCIES FOR LARGE DIESEL GENERATING PLANTS.
Reputable, established company needs territorial sales agencies. Applicants must be thoroughly reliable, long standing, familiar with municipal, central station, and other power requirements. Write
RW-8608, POWER
68 Post St., San Francisco 4, Calif.

WANTED—CHIEF ENGINEER
To operate new 8,000 K.W., 600 P.S.I., 750 degree steam turbine plant now under construction. Located in a City of Wisconsin, Fox River Valley. Must have experience with operation and maintenance of this type plant. Write giving full particulars of education, experience, references and salary expected.
P-8625, POWER
520 N. Michigan Ave., Chicago 11, Ill.

GENERATE YOUR OWN POWER WITH "UTILITIES APPROVED" EQUIPMENT

GREATER VALUES — **PROMPT DELIVERY**

TURBINE-GENERATOR UNITS

3 Phase, 60 Cycle

6250 KVA G.E. condensing, 5 stage, 200# pressure, 600°TT, 2300 volt, 3600 RPM

3125 KVA G.E. condensing, 175/200 psi, 2300 volt, 500°TT, 3600 RPM, complete exciter, switchboard, and condenser.

1875 KVA Westinghouse condensing, 250# pressure, 2400 volt, 3600 RPM, complete exciter, switchboard, surface condenser.

1563 KVA G. E. condensing, 300 to 400 lbs. pressure, 2300 volts, 3600 RPM complete exciter, surface condenser.

1250 KVA, 480 volts, Allis-Chalmers, 150/175 lbs. pressure complete with surface condenser.

625 KVA Westinghouse condensing, 150/200# pressure, 2300 volt, 3600 RPM, complete exciter, switchboard, surface condenser.

625 KVA G. E. condensing, 150-175 lbs. pressure, 480 volts, 3600 RPM complete exciter, switchboard, surface condenser.

625 KVA G. E. non-condensing, 150 lb. pressure, 15 lbs. back, 2300 volts, 3600 RPM complete exciter, panel.

375 KVA (2) G. E. condensing 400 lbs. pressure, 450 volts, each complete exciter, switchboard, surface condenser.

375 KVA G. E. condensing 125 lbs. pressure, 2300 volts, 3600 RPM complete surface condenser and panel.

250 KVA Allis-Moore non-condensing 200# pressure, 40# gauge back, 440 volts, 3600 RPM.

125 KVA G. E. non-condensing, 175 to 200 lbs. pressure, 10 lbs. gauge back, 2300 volts, 3600 RPM complete.

112 KVA Allis non-condensing 175# pressure, 5# gauge back pressure, 240 volts.

100 KVA Westg. non-condensing, 125 to 150 lbs. pressure, 10 lbs. gauge back, 2400/600 volts, 3600 RPM.

TURBINE-GENERATOR UNITS

Direct Current

(2) 400 KW, 240 volts direct current Crocker-Wheeler—Worthington 440 lbs. pressure condensing steam turbine-generator units.

200 KW (3) New General Electric 120 volts Marine type turbine generator units.

150 KW (2) 120 volts, 250 p.s.i., 650°TT Westinghouse Worthington condensing units.

75 KW Allis Chalmers-Terry, 125 volts, 2400 RPM, 150 lbs. pressure non-condensing turbine generator unit.

60 KW (3) new Westinghouse 120 volt Marine type turbine generator units.

SYNCHRONOUS MOTORS

300 HP 80% P. F. G. E. type ATI, 2300 volts, 720 RPM synchronous motor.

900 HP Allis 3 phase, 60 cycle, 2200 volts, 150 RPM synchronous motor.

MOTOR GENERATOR SETS

1500 KW Allis-Chalmers 550/600 volts, 300 RPM direct current generator direct connected 2199 HP, 3 phase, 60 cycle 4000/6600 volts synchronous motor.

500 KW General Electric 600 volt DC, direct connected to 710 HP General Electric 3 phase, 60 cycle, 2300 volt, 720 RPM synchronous motor.

400 KW Gen. Elec. 275 volt DC, direct connected to 710 HP Gen. Elec. 3 phase, 60 cycle, 2300 volt, 720 RPM synchronous motor.

300 KW KW Allis Chalmers, 250 volt DC generator direct connected to a 430 HP Allis Chalmers 3 phase, 60 cycle, 440 volt, 1200 RPM synchronous motor.

62½ KVA G. E. 3 phase, 60 cycle, 2300 volt, 1200 RPM alternator direct connected 75 HP 125 volt DC motor.

50 KW Westg. 125 volt, 1200 RPM direct current generator direct connected 75 HP, 3 phase, 60 cycle, 2300 volt motor.

10 KW, 125 volts DC Gen. Elec. generator with 12 HP, 3 phase, 60 cycle, 220 volts, 1800 RPM motor.

DIESEL GENERATOR UNITS

Alternating Current, 3 Phase, 60 Cycle

375 KVA Fairbanks-Morse, 240 volts, 300 RPM generator direct connected to 450 HP, 300 RPM, 6 cylinder, Model 32-E-14 full Diesel engine complete with switchboard.

(6) 125 KVA Westing., 450 volt, 1200 RPM, direct connected to Gen. Motors Diesel.

DIESEL GENERATOR UNITS

Direct Current

(4) 300 KW, 120/240 volts, 3-wire, 400 RPM Westinghouse direct current generators each direct connected to a 448 BHP Baldwin Diesel engine.

250 KW Crocker-Wheeler, 250 volt, 257 RPM generator direct connected to 360 HP, 6 cylinder late type Fairbanks-Morse full Diesel engine—complete.

STEAM ENGINE-GENERATOR UNITS

Direct Current

400 KW G. E. 250 volts, 360 RPM generator direct connected to Skinner Unaflow vertical non-condensing engine, 150 lbs. pressure, 10 lbs. gauge back.

400 KW Crocker-Wheeler 250 volt, 150 RPM generator direct connected to a 24 x 32 Chuse, non-releasing Corliss engine. 150# pressure, 5# gauge back.

275 KW Westinghouse 250 volt, 350 RPM generator direct connected to Ames vertical Unaflow engine.

200 KW, G. E. 125 volt, 200 RPM generator direct connected Skinner Unaflow engine.

STEAM ENGINE-GENERATOR UNITS (Cont'd)

Direct Current

150 KW Burke 3-wire 250 volt 225 RPM generator, direct connected Skinner Unaflow engine.

STEAM ENGINE-GENERATOR UNITS

Alternating Current, 3 Phase, 60 Cycle

750 KVA G.E., 2300/480 volt, 150 RPM generator, direct connected Skinner Horizontal Unaflow non-condensing engine, 150/175# pressure, 7# gauge back, complete.

500 KVA G. E. 240 volt, 360 RPM generator direct connected Skinner vertical Unaflow non-condensing engine.

312 KVA, 220 volts, Westinghouse 200 RPM generator direct connected Harrisburg-Fleming corlis engine, 125 lbs. pressure.

312 KVA G.E. 2300 volts, 360 RPM generator direct connected 12"x12", 4 cylinders Ames vertical Unaflow non-condensing engine.

156 KVA, 240 volts, 240 RPM generator direct connected to 17" x 16" Skinner Counterflow non-condensing engine 100-125# pressure.

125 KVA Westinghouse 240 volt, 257 RPM generator direct connected to Ames Unaflow engine.

DIESEL ENGINES

(10) 900 HP General Motors, Model 12-567 ATL, 12 cylinders, 744 RPM Diesel engines complete with auxiliaries. Practically new.

ALTERNATING CURRENT GENERATORS

750 KVA Westinghouse 3 phase, 60 cycle, 480 volt, 150 RPM synchronous alternator.

560 KVA Allis 3 phase, 60 cycle, 240 volt, 360 RPM alternator.

500 KVA Westg. 3 phase, 60 cycle, 440/550 or 2300 volts, 514 RPM three bearing belted alternator.

400 KVA Allis 3 phase, 60 cycle, 480 volt, 240 RPM alternator.

312 KVA Westinghouse 3 phase, 60 cycle, 600 volt, 600 RPM alternator.

300 KVA G. E. type ATI, 2300/440 volts, 720 RPM generator.

SPECIALS

1—414 HP Murray 260# pressure, 1—400 HP Walsh-Weidner Combustion, 275# pressure, 1—308 HP Heine 175# pressure water tube boilers.

5425 GPM Worthington 70' head, 1800 RPM centrifugal pump direct connected to 125 HP G. E. 3 phase, 60 cycle, 220 volt slip ring motor.

(2) 1000 GPM, 1270 Ft. Head Morris pumps each direct connected to a 417 HP, 390# pressure G.E. non-condensing turbine.

(1) 700 GPM, 575 Ft. Head Morris Pump direct connected to 180 HP, 200# pressure G.E. non-condensing turbine.

(1) 4400 sq. ft. and (1) 1250 sq. ft. Elliott surface condensers.

10 ton Capacity Brown hand operated traveling crane with 31'10" span including 150" of I-beams.

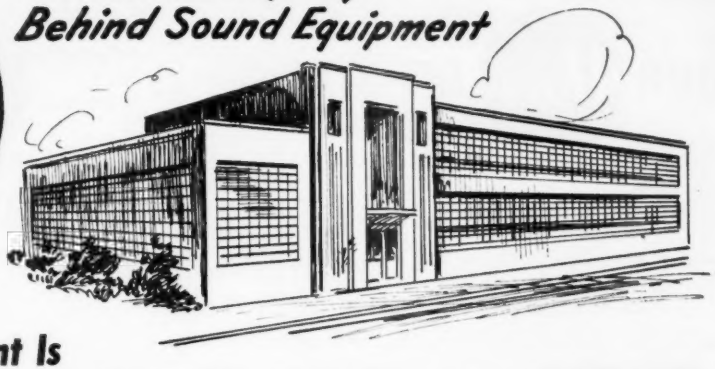
Utilities Electrical Machinery Corporation

600 NATIONAL CITY BANK BLDG
CLEVELAND 14, OHIO

WIRE OR PHONE
LONG DISTANCE 422

JLHCo

A Sound Company Behind Sound Equipment



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REBUILT — THEN TESTED BY ELECTRICAL ENGINEERS

NO ITEM OF HEMPHILL REBUILT EQUIPMENT IS SHIPPED TO THE BUYER UNTIL TESTS PROVE THAT IT WILL GIVE YOU PERFECT SERVICE

TRANSFORMERS

1—1000 KVA G.E., 3 Ph. auto 4150V.—2300V.
1—500 KVA Kuhlman 4150 V. Pri. 2300 V. Sec.
3—400 KVA G.E., 6900 Primary—2300 Secondary
3—300 KVA Pitts., 2300 V. Pri., 115/230 V. Sec.
3—300 KVA, G.E., type H, 2300 V Pri., 115/230 V. Sec.
300 KVA, Pitts., 7800-440 v.
205 KVA, Whse., 2 ph., 2300 to 3 ph., 4150 auto.
200 KVA, 4000 v.—110/220
100 KVA, Pitts., 1375/2750 v. — 110/220.
3—100 KVA, Wagners, 240/120 v.—120 v.
2—100 KVA, Newark, 440 v., 3 ph. to 220 V., 2 ph.
2—100 KVA, Whse., 13800 v. to 250 v.
3— 75 KVA, G.E., 2400 v.—120/240
3— 50 KVA, Whse., 2400 v.—120/240
6— 50 KVA, Whse., 13,800 v. to 125 v. or 250 v.
6— 50 KVA, Whse., 6900 v. to 125 v. or 250 v.

A. C. GENERATORS

2500 KVA, Whse., Syn. Cond., 720 RPM, 2400 v.
500 KW., 8 P.F., 3600 RPM, ATB. 600 v.
320 KW, Allis, 450 RPM, 480 v.
240 KW, G.E., ATB, 600 RPM, 600 v.
200 KVA, Allis, 3600 RPM, 240 volt
200 KVA, Whse., 600 RPM, 240 v.
180 KW, Whse., 514 RPM, 550 v.
100 KW, G.E. ATB, 600 RPM, 240 v.
75 KW, Whse., 900 RPM, 220 v.
62½ KW, Allis, 3600 RPM, 220 v.
7— 50 KVA, Whse., 900 RPM 220 v.
3— 35 KWA, Columbia, 1200 RPM, 240 v.
1—31.3 KVA, America, 1200 RPM, 120/208.
15 KW, Star, 1800 RPM, 220/440.
12.5 KVA, Whse., 1200 RPM, 240 v.

TURBINE BLOWERS

1—Spencer, 1000 cubic feet, 30 oz. pressure with a 15 H.P., 3600 RPM, General Electric Type FT 200 volt motor.
1—Bellmore, 550 cubic feet, 7 inch vacuum, with a 20 H.P. 3600 RPM, General Electric, Type K, 220 volt 3 phase motor.

MOTORS, 3 Phase, 60 Cycles
SQUIRREL CAGE

750 H.P., G.E., 750 RPM, 6600 v., 25 cycle.
450 H.P., Ridgeway, 900 RPM, 2200 volts.
125 H.P., G.E., KF, 1750 RPM, 2200 v.
125 H.P., U.S., 1200 RPM, Vert., 220 volts.
100 H.P., G.E., 400 RPM, 440 volt.
75 H.P., West., CS, 1750 RPM, 440 volts.
60 H.P., Whse., 900 RPM, Vert., 2200 volts.
60 H.P., Whse., 900 RPM, 440 volts.
2— 40 H.P., G.E., 900 RPM, 220 volts.
40/20 H.P., Westinghouse 600/450 440 volt.
35 H.P., Whse., 1200 RPM, CS, 2200 volts.

MOTORS, 3 Phase, 60 Cycles
SLIP RING

2500 H.P., G.E., 257 RPM, 6600 volts.
450 HP., G.E., 425 RPM, ITC, 440 volts, 25 cycle.
2— 170 H.P., G.E., 1M, 440 volt, 450 RPM.
100 H.P., G.E., 1M, 440 volt, 25 cycle, 720 RPM.
1— 100 H.P., G.E., 1M, 440 V. 400 RPM.
75 H.P., Whse., CW, 720 RPM, 440 volt.
75 H.P., G.E., MT, 1200 RPM, Vert.
50 H.P., G.E., MT, 600 RPM, 220 volt.
2— 50 H.P., Whse., CW, 900 RPM. 220 volts.
40 H.P., Cont., 1200 RPM, JA85 220 volt.
40 H.P., G.E., 1200 RPM, MT, 220 volt.
40 H.P., G.E., 900 RPM, 220 Volt, ITC.
40 H.P., G.E., 900 RPM, MT, 900 RPM, 220 volt.
40 H.P., G.E., 900 RPM, 2200 volt.

DIESEL GENERATOR SETS

3—300 KW 125/250 V. De La Vergne Baldwin 6 cyl. 4 cycle with Westinghouse generators

LARGE STOCK OF D. C. MOTORS AND GENERATORS

SYNCHRONOUS MOTORS

4—200/100 H.P., Whse., 720/360 RPM. 4150 v.
200 H.P., Whse., 600 RPM, 240 v.
1—200 H.P., G.E., 257 RPM, 440 volt.
1—150 H.P., G.E., 1800 RPM, 220 v., TS
2—150 H.P., Allis-Chalmers 360 RPM, 2200 V.
75 H.P., G.E., 1200 RPM, 440 v.
70 H.P., Elect. Mach., 180 RPM, 2200 v.
40 H.P., Whse., 1800 RPM, 220 v.
35 H.P., G.E., 1200 RPM, 2200 v.
20 H.P., Whse., 1800 RPM, 220 v.

MOTOR GEN. SETS

1—1000 KW., Whse., 275 V.—4150—720 RPM Syn.
1—1000 KW, G.E., 600 volts—4150—514 rpm. Syn.
1— 400 KW, G.E., 250 V. 900 RPM, 2300 V. Syn.
1— 500 KW., G.E., 575 V. 900 RPM, 2300 V. Syn.
125 KW., CW, 125 v., 1200 RPM, 2300 v. sq. cage.
100 KW, El. Mach., 125 v., 1200 RPM, 4150 v. syn.
100 KW, G.E., 230 v., 900 RPM, 4150 v. Syn.
2— 75 KW., G.E., 125 v., 1200 RPM, 220/440 v.
6— 75 KW., G.E., 60 v., 1200 RPM, 220/440 v.
50 KW., Ridgeway, 550 v., 1200 RPM, 220 v.
25 KW., G.E., ATI, 1800 RPM, 40 HP, 1800 RPM, 230 v.

PLATING M.G. SETS

250 amp. G.E., 5/6 volt, 220 v.
500 Amp., Hansen Van Winkle, 24 volt, 220/440 v.
2500 Amp., Chandeysson, 6/12 v., 400 RPM, Syn., 440 v.
3000 Amp., Chandeysson, 6/12, 400 RPM, syn., 440 v.

ENGINE GEN. SETS

150 KVA, G.E., Ames Uniflow, 220 v., 3 ph., non cond.
2— 5 KW., Gasoline, Hobart, 1800 RPM, 120 v., 1 ph. cond. engines.
1—200/275 H.P., Gasoline Engine, Van Blerck, 8 cylinder, 1500/900 rpm.

TURBO GEN. SETS

625 KVA Whse, 2400 v., 3 phase, non-con.
300 KW, G.E., ATB, 240 v., 3 ph. cond.
60 KW, Whse., 120 v., D.C., cond.

STEAM TURBINES

500 HP., G.E., 3 stage, 165#, 3240 RPM.
800 HP., Terry Tandem type, 720 RPM, red. gear.

A GUARANTEE IS NO BETTER THAN THE COMPANY THAT GIVES IT — IT PAYS TO GET A *HEMPHILL* GUARANTEE

JLHCo

THIS SEAL IS YOUR GUARANTEE

"FOR POWER"

J.L. HEMPHILL & CO.

1604 53rd STREET, NORTH BERGEN, N. J.

PHONE NEW YORK—LONGACRE 5-3227

PHONE NEW JERSEY—UNION 3-2600

Something to remember:

OUR 41 year REPUTATION IS YOUR PROTECTION

WHEN YOU BUY RE-NU-BILT FROM BELYEA

RE-NU-BILT EQUIPMENT

Rebuilt in accordance with N.I.S.A. Rebuilding Standards

MOTOR GENERATOR SETS

3 ph. 60 cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1	1800	G.E.	600	125/250	4000
1	1500	G.E.	600	600	2300/4150
1	1500	G.E.	360	275	2200/4400
1	1250	G.E.	600	275	2300
1	1000	Whse.	900	600	2300/4150
1	1000	Whse.	720	600	2300/4150
1	1000	West.	514	250	4150
1	1000	Whse.	514	600	4150
1	1000	Ck. Wh.	720	250	2300/4150
1	900	G.E.(2U)	1200	120/240	2300
1	750	Whse.	900	250	2300
2	500	G.E.	720	600	2300/4150
1	500	G.E.	720	125	2300/4000
1	500	G.E.	900	250	2300/4000
1	400	G.E.	720	250	440/2300
1	400	G.E.	1200	120/240	440
1	350	G.E.	900	125	2300/4150
1	300	G.E.	1200	250	440
1	150	Cr. Wh.	1200	250	440
1	100	G.E.	1170	125	220
1	100	G.E.	1200	250	2200

SYNCHRONOUS CONDENSERS

Qu.	Kva.	Make	Type	Volts	Speed
1	5140	Whse.		4150	600
1	4000	G.E.	TSC	2400/4800	900
1	3000	Whse.		4800	720
1	3000	G.E.	ATI	4800	720

ROTARY CONVERTERS

60 Cycle

KW	Make	Speed	D.C. Volts	A.C. Volts
1—2000	G.E.	514	600	13800
1—2000	G.E.	450	600	2300
—1000	Whse.	900	600	11000
1— 750	Whse.	900	600	13200
1— 500	Whse.	900	250	2300

D. C. MOTORS

HP	Make	Type	Volts	Speed
1—1750	Whse		600	525/720
2—1500	Whse.		525	600
1—1200	Whse.		600	425
1—800/1000	Whse.		450	600/720
1—700	G.E.	MCF	600	150/525
1—650	G.E.	MPC	250	115/145
1—300/400	G.E.	DYNA	250	1325/2500
1—335	Whse.	35Q	250	300/900
1—200/300	G.E.	MPC	230	360/920
1—275	Whse.	QM-600-6	230	425/850
1—250	G.E.	MPC	230	400/500
1—230	Al. Ch.		230	700
1—150	G.E.	MPC	230	250/450
1—150	Cr. Wh.	CCM	230	300/1050
1—150	G.E.		600	250/750
10—150	Cr. Wh.	83H	230	890
1—150	Cr. Wh.	CMC-65H	230	1150
2—125	G.E.	CO-1832	230	625
1—125	El. Dy.	305	230	750/1500
1—115	Cr. Wh.	JHL	230	1200
3—101	Whse.	SK	230	485/950
2—100	Rel.	1050T	230	400/1200
1—90	G.E.	CDM-1242Z	115	1800
1—50/100	G.E.	CD-175	230	365/730
2—80	El. Dy.	308	230	475/1350
1—75	Whse.	SK-100L	125	650
2—75	El. Dy.	25-SL	230	750/1750
3—60/75	Whse.	SK-200	115	300/700
4—75	Cr. Wh.	53-H	230	850
2—75	G.E.	CDM-1126Y	230	2000
1—60	Whse.	SK-160	550	680
1—60	El. Dy.	25-S	230	525/1050
1—60	Whse.	SK	230	500/1000
1—60	Whse.	SK-131	230	500/1500
1—60	El. Dy.	258	230	750/1500
2—50	G.E.	RCP-31B	230	1700
4—50	Whse.	Hoist	230	400
1—50	Whse.	SK-153	230	690/1035
1—50	Cr. Wh.	CMC-80H	230	380/750
3—40	Rel.	385 T "V8"	230	400/1500

with 40 KW MG sets, 230 v. DC, 220/440-3-60 Exciters and automatic "V8" control.

A. C. MOTORS

3 ph. 60 cycle

SYNCHRONOUS

HP	Make	Type	Volts	Speed
2—3500	G.E.	TS	2300	257
1—2100	G.E.	ATI	4600	514
2—2000	Whse.		2300	120
1—1000	Whse.		2300	1894
2— 900	Al. Ch.	(New)	2200	150
1— 600	Whse.	Syn.	440	360
1— 500	G.E.	ATI	485	900
2— 500	G.E.	TS	4150	600
1— 450	Whse.	Eng.	2200	128.5
2— 350	G.E.	TS	2200	150
1— 320	G.E.	ATI	2300	600
1— 300	G.E.	ATI	440	720
1— 300	Whse.		2300	720
1— 300	Al. Ch.		440	600
1— 145	G.E.	ATI	550	720
2— 125	G.E.	ATI	440	450
1— 100	Whse.		550	600
2— 100	G.E.	TS8-7651	440	450
1— 100	G.E.	TS	440	1800
1— 100	F.M.	Unused	440	600

SLIP RING

1—1000	Whse.	CW	2300	709
2— 700	Whse.	CW	2300	900
1— 500	G.E.	IP	550	505
1— 500	G.E.	IM-MIII	2200	450
3— 450	G.E.	IM	440	506
1— 400	G.E.	IM	440	720
3— 350	Whse.	CW	2200	900
1— 350	G.E.	MT-442Y	2200/4000	253
1— 300	Al. Ch.	3 Brg.	2300	505
1— 300	G.E.	IM	440	720
1— 250	G.E.	MT-424Y	4000	257
1— 250	G.E.	MT-559S	2200	1750
1— 135	G.E.	IM	2300	720
4— 100	GE	MT-566Y	440/2200	425
2— 100	G.E.	IM-416	2200	435
1— 75	Whse.	CW-761	2300	1257
1— 75	F.M.	Bv-H16B	2300	1800
1— 60	Cr. Wh.	123-AQ	220	700
3— 50	Whse.	CI-638A	220	870
2— 50	Whse.	CIW-504	440	870
1— 50	Rel.	IXM	2300	880

SQUIRREL CAGE

1— 250	G.E.	KT-559	440	1800
1— 200	G.E.	IK	550	865
1— 200	G.E.	KT-557	440	1800
1— 150/50	Whse.	CS	440	879/343
1— 125	Whse.	MS	440	485
1— 125	(New) G.E.	KF-TEFC	440	1190
1— 125	G.E.	KF-TEFC	440	3585
1— 100	G.E.	IK	440	575
1— 100	G.E.	IK-Vert.	2300	450
2— 100	G.E.	KT-543	220/440	1750
1—60/20	Whse.	CS	220	900/450

FREQUENCY CHANGER SETS

1—1000 KW—Al. Ch. Consisting of 1400 HP, 2300 V. 3 ph. 25 cy. Motor and 1000 KW, 2300 V. 3 ph. 62½ cy. gen. switch exciter

1—1000 KW—GE—2 unit—3 Brg. Consisting of—1400 HP—4400 V., 3 ph. 25 cy. Motor and 1000 KW—2300 V. 2 ph. 58.3 cycle gen. with exciter (Gen. can be reconnected for 800 KW 3 ph.)

1—320 KW—GE—2 Unit—3 Brg. consisting of 600 HP—440 V., 3 ph. 60 cy., .8 pf. Syn. Motor and 400 KVA, .8 pf, type AT—3 ph, 120 cy, 720 volt AC generator with direct connected exciter.

SPECIAL—MERCURY ARC RECTIFIERS

1—750 KW—GE—Type RHW—6 Anode 575 V., D.C. Form C with 2300 V., 60 cycle transformer and switching equipment.

1—1000 KW—American B.B. Type GRZ-612—12 anode 625 V.D.C. with 1040 KVA O15C—3 phase—13200/6600V-25/60 cycle transformer with full automatic switching equipment along with 2 distribution panels.

1—1000 KW—Al.Ch. type B-612—12 anode 625 V.D.C. with 1140 KVA O15C—3 phase—13500V.—60 cycle transformer with manually operated switching equipment along with voltage regulator and grid control.

Turbo Generators

See our advertisement on page 292

BELYEA CO. INC.

Main Office and Shop

43 HOWELL ST., JERSEY CITY 6, N. J.

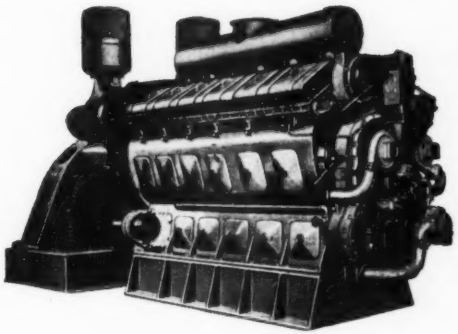
Phone—Journal Square 2-3334

Also N. Y. City Line—Rector 2-7150

DIESEL POWER PLANTS

OFFERED FOR QUICK DELIVERY

FROM AGSCO



1080 BHP GENERAL MOTORS DIESEL ENGINE MODEL 12-567 WITH DIRECT CONNECTED G. E. ALTERNATOR RATED 900 KVA, 3 PHASE, 60 CYCLE, 2400 VOLTS.

• 50 AND 60 CYCLE OFFERINGS •

ALTERNATING CURRENT DIESEL GENERATORS

KVA	Make	Model	HP	RPM
1420	Fairbanks-Morse	38D8⅛	1600	720
1250	General Motors	16-278A	1600	720
1250	Nelseco	6M1-53	1500	300
1000	General Motors	12-278A	1200	720
900	General Motors	12-567	1080	720
800	Alco	6-12½ x 13T	975	720
625	Baldwin	VO-8	750	514
625	Superior	OS	750	327
425	Baldwin	VO-6	510	450
400	Buckeye	80	480	600
375	Enterprise	DSG-6	450	450
312	General Motors	8-268A	450	1200
250	General Motors	8-268A	350	1200
200	Buckeye	80	240	600
125	Superior	GDB-8	150	1200
125	General Motors	3-268A	150	1200
125	Murphy	ME-605	150	1200
121	Fairbanks-Morse	32E14	140	300
75	General Motors	6043E	90	1200
75	Fairbanks-Morse	35E8¾	90	450
62	Int'l Harvester	UD-18	76	1200
50	General Motors	4-71	60	1200
18	Int'l Harvester	UD-6	22	1200

Engineered AGSCO DIESEL POWER

A. G. SCHOONMAKER Company, Inc. ESTABLISHED 1895

Diesel Engines • Power Machinery

52 CHURCH STREET, NEW YORK 7, N. Y. PHONE Digby 9-4350

L. J. LAND
Guaranteed Electrical Equipment

1 YEAR GUARANTEE

RELIABLY REBUILT—DEPENDABLE EQUIPMENT

PARTIAL LISTINGS ONLY

SQUIRREL CAGE MOTORS

H.P.	Make	Type	Speed
450	G.E. vert.	KF-6338	1180
250	G.E.	IK	1160
250	G.E. (2)	K-568	575
200	G.E.	KF-6333Z	880
147	West.	25 cy.	1750
125	Al. Ch.(2)	AR-630F	450
100	G.E. (2)	K-544	1175
100	West.	CS	870
100	G.E.	KT-356	865
100	West. (2)	CS	690
75	West.	CS-5038	1760
75	West.	CS-862C	1150
75	West.	CS	670
60	West.	504-S	1750
60	Rel.	AA-C5084Z	870
50	G.E.	FTR-523	3600
50	Elliott	196	3450
50	G.E.	K-445	1170
50	West.	CS	870
40	G.E.	KT-336	900
40	West.	CS	900

SLIPRING MOTORS

600	Cr. Wh.		514
200	G.E.	MTP	1800
200	G.E.	IM	1200
150	G.E.	MT-564Y	580
100	G.E.	IM	1800
100	Al. Ch.		690
75	G.E.	IM	870
75	G.E.	MT	870
75	G.E.	IM	690
60	Al. Ch.		690
60	G.E.	M-6326TEFC	705
50	West.	CW-554	1155
50	Al. Ch.	ARY	575
50	F-M	BV	575
50	G.E.	IM	490
40	G.E.	IM	1200

SYNCHRONOUS MOTORS

H.P.	Make	Type	Speed
600	G.E.	TS	900
400	G.E. (4)	TS-982S	600
260	G.E.	TS	900
200	Ideal (2)		257
180	G.E.	AT1	900
150	G.E.	AT1	720
150	G.E.	TS	1200
125	West.	G	1200
100	Elec. Prods.		1200

A. C. GENERATORS

288	KVA	West.	G	900
200	KW	West.	G	1200
75	KW	G.E.	ATB	360
75	KW	G.E.	ATB	1200

D. C. to A. C. GENERATORS

K.W.	Make	D.C.	A.C.
25	G.E.	230	220
25	Star	115	120
25	Ideal	115	440
25	El. Mchy.	230	440
7½	Hertner	115	440
5	El. Spec.	110	110

600 V. GENERATOR

K.W.	Make	Speed
200	Cr. Wh.	900
30	Burke	1750
30	E.D.	1150

250 V. GENERATOR

K.W.	Make	Speed
500	West.	1100
330	Elliot	1200
300	G.E.	1200
300	Al. Ch.	1200
200	G.E. MPC	1200
150	West.	900
150	West.	1180
150	G.E.	600
50	G.E.	1200
40	Reliance (4)	1750
30(3)	G.E.	1750
30	Cont.	1200
25	G.E.	1200
15	G.E.	1750
10	Star	1750
7½	West.	1200
5	West.	1750

125 V. GENERATOR

K.W.	Make	Speed
250	G.E.	720
150	Cr. Wh.	1200
150	West.	1150
100(2)	West.	900
100	G.E.	1200
100	El. Mchy	1200
75	Cr. Wh	1200
75	Hertner	1150
50	Sturt.	2600
40	Cont.	1450
30	Ideal (2)	1750
30	L.A.	1450
30	G.E.	1150
20	Delco	1200
15	G.E.	1150
10	Rogers	1450
7½	West.	1200
5	G.E.	1750

LOW VOLTAGE GENERATOR

Amp.	Make	Voltage
8000	H-V-W	6/12
3000	M-B-C/C(2)	6/12
2000	H-V-W	6/12
1000	Chandeysson (2)	6/12
1000	Cal.	6/12
125	Hobart(8)	7½
3000	Chandysson	12/24
1000	H-V-W	12/24
300	Star	15
67	Cons.	15
750	Star	15
1000	G.E.	15
800	G.E.	22 28
600	Rel.	24
134	West.	24

LOW VOLTAGE GENERATOR (Cont.)

175	Cr. Wh.	25
550	Cal.	27
1600	G.E.	30
800	G.E.	30
100	G.E.	30
200	West.	30
205	G.E.	32
1000	G.E.	38
1000	Chandysson (4)	40
500	Chandysson (3)	40
205	G.E.	42
24	G.E.	44/54
75	G.E.	50/10
800	G.E.	50

550 V. D. C. MOTORS

H.P.	Make	Type	Speed
765	G.E. (6)	MPC	1045/1350

230 V. D. C.
Variable Speed Motors

100	Rel.	1050-T	400/1200
100	G.E.	CD-173	400/1200
75	G.E.	D	500/1500
75	Cr. Wh.	CMC-125H	375/750
60	G.E.	C	480/1100
55	Cr. Wh.	CCM-125H	165/800
50	West.	SK	500/1500
50	West.	SK	250/1000
40	Reliance	461T	400/1200
40	G.E. (3)	CD-1441	400/1500
25	West.	SA	500/1500
23	Rel.	185-T	500/1500
25	G.E.	RF-13	400/1600
25	G.E.	RF-14	400/1200
25	G.E.	RF-14	300/1200
20	G.E. (6)	RF-12	400/1200
20	West.	SK	375/1500
15	West. (4)	SK-95	600/1500
15	E.D.		500/1500
15	West.	SK-120	350/1000
15	West.	SK	250/1000
15	West.	SK	500/1500
10	G.E.	RF-10	600/1800
10	G.E.	CD-83	600/1800
10	West.	SK	600/1200
10	West. (3)	SK	500/1500
10	G.E.	RF	400/1600
10	G.E. (3)	RF	400/1200
10	Rel.	131-T	250/1000
7½	West.	SK-70	500/1500
7½	G.E.	RF-10A	450/1600
7½	Al. Ch.		350/1050
5	West. (3)	SK-60	500/1500
5	G.E.	RF-9	450/1800
5	G.E.	RF	450/1800
5	Rel. (2)	46-T	400/1600

230 V. D. C. MOTORS

150	G.E.	RC-19	800
125	G.E.	CDP125	1300/1750
100	G.E.	RC-14	1750
100	G.E.	RC	1050
75	West.	SK-170	635
75	West. (2)	SK-180	475
75	Cr. Wh.	52-HM	480
60	West. (2)	SK-160	680
50	West.	SK-133	1300
50	Diehl	K-10	850

230 V. D. C. MOTORS (Cont.)

50	West.	SK	750
50	West. (2)	SK-160	585
40	West.	SK-103	1750
40	Century	DN-454	1740
40	G.E.	RC	1750
40	G.E.	RC-32	1100
30	G.E. (2)	RC-13	1075
30	G.E. (2)	RC	1200
30	West (2)		975
30	G.E. (2)	RC-33	775
30	West. (2)	SK-143	575
20	G.E. (2)	CD-83	1750
20	G.E. (2)	RC-11	1150
20	Star (2)	SR-316	29 2

115 V. D. C. MOTORS

300	West.	SK	900
100	Cr. Wh.	CMC	900
25	G.E. (2)	CD	1800
25	Cr. Wh.	CCM	750
20	Century	R8	1750
20	G.E. (2)	CD-83	1750
20	West.	SK-110L	750
12½	G.E.	CDM-85	930/1160

TRANSFORMERS

75 KVA—G.E., 2300/4160 V. primary, 220/440 V. secondary.
300 KVA—Al. Ch. 3 phase, 4160 V. primary, 230 V. secondary.
300 KVA—Pittsburgh, 3 phase, 4160 V. primary, 230 V. secondary.

NEW D. C. STARTERS

150—230 V. Magnetic 5 H.P. to 75 H.P. G.E.—C-H—A-B—W.L., etc.
100—230 V. Manual and Compound 1 H.P. to 5 H.P.—G.E. & C-H.
40—7½ H.P. 230 V. C-H—Magnetic reversing.

A. C. STARTERS

1—475 H.P. West. Magnetic Reduced voltage, 550 V. synch.
4—400 H.P. 440 V. C-H Bal. 1875 Mag. Red. Volt. Synch.
1—250 H.P. C-H 4150 V. synch. full voltage.
1—150/200 H.P. G.E.—440 V. CR-7061 Syn.
3—150 H.P. G.E. 220 V. Cr. 7061 Synch.

NEW A. C. STARTERS

40—C-H. & A-B 2 and 4 speed Magnetic up to 25 H.P.
20—50 H.P. C-H. 440 V. Magnetic.
165—20 H.P. W.L. 440 V. Magnetic.
635—7½ H.P. C-H. 440 V. Magnetic.

AIR COMPRESSORS

425 Cfm. Sullivan 2 stage.
360 Cfm. American 125 lbs.

ELECTRIC & AIR HOISTS

17—2 ton Shepard-Niles 230 V. D.C.
8—500 lbs. P & Z. Zip Lift, 3 phase.
2—2 ton Yale & Towne, 3 phase.
1—1 ton Shepard-Niles, 3 phase.
1—½ ton Yale & Towne, 3 phase.
1—2 ton Thor, pneumatic.
1—½ ton Thor, pneumatic.

400 CY. GENERATORS

2—3 K W GE 3/400/110.
1—7½ K W GE 3/400/240.
1—10 KW GE 200/700 Cy.
1—15 KW GE 3/400/240.

EST. 1910 — L. J. LAND INC. — 40th YEAR

156 GRAND STREET — Phone CAnal 6-6976 — **NEW YORK 13, N. Y.**

New England Representative
411 Atlantic Ave., BOSTON, MASS
Phone Liberty 2-4300

South Western Representative
1400 Carr St., HOUSTON, TEXAS
Phone: Charter 4-6558

Pennsylvania Office
10th and Exeter Sts., READING, PA.
Phone Reading 2-6866

POWER EQUIPMENT—READY TO SHIP

SAVE OVER 50% ON NEW INDUSTRIAL BLOWERS AND VENTILATING FANS

AXIAL FLOW VENTILATING FANS

1—16000 CFM Buffalo Forge Co., 3" stat. pres. 1800/1200 rpm. con. 15/4.5 HP., 1710/1150 rpm., 3 ph. 60 cy. G.E. A.C. Motor 220/440 v. totally enel.
1—12000 CFM 3" stat. pres. Sturtevant with dir. con. 10/3 HP., 1775/1180 rpm., 220/440 v. West. CS. TEFC Motor.
25—6000 cfm Sturtevant Bulletin 512389, 3" stat. pres. 7 blade, dir. con. 5/1.5 HP., 1765/1175 rpm., 220/440 v. 3 ph. 60 cy. West. TEFC Motors.
2—5000 cfm Sturtevant 1.8 stat. pres. 4.2/1.25 HP., 1750/1150 rpm., 3 ph. 60 cy. 220/440 v. ball bearing motors.
2—4000 cfm 3" stat. pres. Sturtevant dir. con. 2 speed, TE Westinghouse 220/440 v. Motors.

BRAND NEW TURBO SET

Westinghouse Steam Turbine consisting of 200 kw., 220/440 v., 3 ph. 60 cy. 1200 rpm., 80% P.F. A.C. Generator—40 kw., 120 v. 1200 rpm., D.C. Exciter and Westinghouse Reduction Gear. — Non-condensing.

A.C. MOTORS—3 PH. 60 CY.

No.	H.P.	Make	Type	RPM	Volts
1 NEW	500	Elec. Mach.	Syn.	120	4000/2200 220/440
1 NEW	200	Westing.	Syn.	1200	220/440
2	300	G.E.	IE	1200	2200
2 Vert.	250	G.E.		1200	2200
2	200	Westing.	CS	900	2300/4000
1	200	G.E.	Syn.	1800	2200/440/220
1	175	Westing.	Hi-torq.	1200	220/440
1	150	Westing.	Syn.	257	220/440
1	150	Westing.	Syn.	450	220/440
1	150	Westing.	CS-956A	880	4000/2300
3	150	Westing.	CS-856S	880	220/440
1	150	Westing.	MS	1200	220/440
3	150	Louis Allis splash proof	FX	180	220/440
1	125	Elec. Mach.	Syn.	164	220/440
1 NEW	125	Elec. Mach.		585	4160/2300
1	125	Westing.	CS	690	220/440
1	125	G.E.	IK	900	440/220
1 TEFC	125	Westing.	CS	3600	220/440
1	100	Reliance	IT	495	220/440
1	100	Westing.	CS	580	220/440
1	100	G.E.	IK	720	220/440
1 Vert.	100	G.E.	XFR	885	220/440
1	100	Wagner		850	220/440
1	100	Westing.	Syn.	900	220/440
1	100	Westing.		1200	220/440
2 TEFC	100	Master	PA	1750	220/440
1	100	Armour	AB	1750	220/440
1	100	Louis Allis splash proof	OGS	1750	220/440
1	75	Stanley		600	220/440
1	75	Chandey	Syn.	600	220/440
1	75	G.E.	IK	600	220/440
1	75	G.E.	KF	900	220/440
1	75	Elec. Mach.	Syn.	900	220/440
1	75	G.E.		720	220/440
1	75	G.E.	KT	1150	220/440
1	75	Louis Allis splash pr.	Hi. Tor.	1150	220/440
3	75	Armour		1200	220/440
1	75	Westg.	TEFC	1750	220/440
2	60	G.E.	IK	600	220/440
1	60	G.E.	KF	700	220/440
1	60	Burke	EM	900	220/440
2	60	G.E.	KT	900	220/440
2	60	Westg.	CS	900	220/440
3	60	Westg.	CS	1200	220/440
1	60	G.E.	KT	1800	220/440

A. C. GENERATORS—3 ph. 60 cy.

No.	KVA	Make	RPM	Volts
1 new	450	Elec. Mach.	120	4000/220 220/440
1 new	250	West.	1200	220/440
1	100	Elec. Mach.	164	220/440
1	100	West.	600	220/440
1	75	Elec. Mach.	900	220/440
1	50	G.E.	1200	220/440
1 new	50	Elec. Mach.	1200	220/440
1	37½	Ft. Wayne	1200	200/440
1 new	25	G.E.	900	220/440
	25	O'Nan	1800	220/440

BARGAIN — FOR SALE
100 KW. DIESEL ENGINE GENERATOR SETS

10—100 KW, 120/240 V D.C. Delco Generators dir. con. to 150 HP., Model GBD-8, 8½x7, 8 cyl. Superior Diesel Engines, elec. starting with muffler, power panel and accessories.
1—100 kw 220/440 V AC same as above.
Practically as good as new—Only Used for Spares.

250 VOLT D.C. GENERATORS

No.	KW	Make	Type	RPM
3	250	West.		1200
1	200	West.	SK	500
1	110	West.	SK-190	700
8	100	Reliance	1050-T	580
1	100	West.	SK-183	720
1	100	West.	SK-190	720
1	100	West.	SK-180	900
6	100	Delco		1200
1	100	G.E.	RC-58	850
1	100	West.	SK	850
1	100	G.E.	RCP-36	2100
1	75	Allis Chal.		850
2	75	West.	SK	1400
1	60	West.	SK	2100/1950
1	60	West.	SK-153	1100
1	50	West.	SK-180	400
1	50	G.E.	DLC-203	850
1	50	West.	SK-143	1100

MOTOR GENERATOR SETS—250 V.D.C.
Motors 220/440 volt or 2200 volt 3 phase, 60 cycle

No.	KW	Make	RPM
3	250	Westinghouse	1200
1	200	Westinghouse	720
2	200	Westinghouse	1200
1	100	Westinghouse	700
1	100	General Electric	900
1	100	Westinghouse	600
1	100	General Electric	1800
1	100	Reliance	580
1	100	Delco	1200
2	90	Westinghouse	680
4	75	Westinghouse	720
1	75	Westinghouse	1200
1	60	Westinghouse	1200
1 NEW	50	General Electric	1800
3	40	Westinghouse	900
2	30	Westinghouse	720

VARIABLE SPEED MOTORS—230 V. D.C.

No.	HP	Make	Type	RPM
1	200	West.	SK	400/1000
6	100	Reliance	1050-T	400/1000
1	100	G.E.	RC	650/1200
2	100	West.	SK-183-A	575/1150
1	100	West.	SK-190	500/1000
1	100	West.	SK	600/1200
1	75	West.	SK	1100/1800
2	75	West.	SK	850/1700
1	50	West.	SK-180	320/960
1	50	West.	SK	300/1200
1	50	West.	SK-191	350/1050
1	50	West.	SK-143	850/1750
1	40	Allis Cha.		400/1200
3	30	G.E.	DLE-50	400/1200
1	30	G.E.		800/1200
1	25	G.E.	CD-123	300/1200
1	20	West.	SK-123	400/1600
1	20	G.E.	RF-11	500/1500

SPECIAL BARGAIN AIR COMPRESSOR

6—240 CFM Westinghouse type 3 VB-23 3 cyl. vert., 150 lbs. pres. dir. con., to 50 HP., 220/440 or 2200 v. 3 ph. 60 cy. West Slip Ring Motors, auto. control. Can furnish D.C. Motors or Oil or Gasoline Engines if desired.

SLIP RING MOTORS—3 ph. 60 cy.

No.	H.P.	Make	RPM	Volts
1	1000	G.E.-MT	900	2200/440
1	800	G.E.-MT	900	2200/440
2	800	West. CW	807	6600
1	600	G.E.-MT-415	900	2200/4000/220/440
1	350	West. CI	1150	220/440
1	250	Allis Chal	870	2300
1	250	West. CI	1150	220/440
1	250	West. CW	1800	220/440
1	200	West. CW	1800	220/440
1	150	West. CW	1150	2200/220/440
1	125	West. CW	860	2200/220/440
1	100	West. CW	720	2200/220/440
1	100	Triumph C-17	580	550/440/220
1	75	G.E. I-M	720	220/440
1	75	West. CW	1800	220/440
1	60	West. CW	900	220/440
1	60	G.E. IM	720	220/440
4	50	West. CW	870	2200/220/440

25 CYCLE A. C. MOTORS
3 ph. — 220-440 volts

H.P.	Make	Type	RPM
1 500	G.E. MT	365	2200/440/220
1 300	G.E. MT	365	2200/440/220
300	G.E.	MT-415	375
150	West.	CW	400
75	West.	MS	400
75	G.E.	M	715
60	West.	CS	1450
50	L. Allis	OGS-115	730
50	Armour	AB-1	720
50	West.		475
40	West.		725
25	West.	MS	715
20	West.	CS	715
20	Allis Chal.		715

125 V. DC M.G. Sets

1—100 kw. G.E. 125 v. 900 rpm. 220/440 v. 3 ph. 60 cy. AC Syn.
1—125 kw. G.E. 125 v. 1200 rpm. 220/440 v. 3 ph. 60 cy. AC.
1—75 kw. West. 125 v. 1200 rpm. 220/440 v. 3 ph. 60 cy. Syn.

FREQUENCY CHANGERS

1—25 kw., 220/440 v. 3 ph. 180 cy., G.E. dir. con. to 25 HP., 1800 rpm., 220/440 v. 3 ph. 60 cy. motors.

SYNCHRONOUS MOTORS

1—New 500 HP., Elec. Machy. Co. 2200/220 or 440 v. 120 rpm.

ENGINE GENERATOR SETS

10—NEW 1 kw. 14.25 v. D.C. and 2 kw., 28.5 v. D.C. Homelite portable gas eng. Gen. sets. Can furnish lamps and batteries. Suitable for farms and camps.
3—5 kva. 120/240 v. 1 ph. 60 cy. Witte Diesel.
2—37½ KVA 220/440 volts 3 ph. 60 cy. Buda DIESELS
1—125 kva. 220/440 v. 3 ph. 60 cy. 257 rpm., Erie Ball STEAM.
1—125 kva. G.E. 220/440 v. 3 ph. 60 cy., dir. con. Skinner UNIFLOW Engine.

INDUCTION HEATING CONVERTER

New Van Norman, type indoor, floor, hi-freq. 32 kw. 220 v. 1 ph., 60 cy. 150 A. enclosed type.

HOISTS or WINCHES

200—1½ Ton HAND CRANKED ratio 27:1 thru an enclosed double reduction gear unit with 4 planetary gears mounted on steel plate complete with 43' of ¼" cable, ratchet type brake, push button release.

GEAR HEAD MOTOR

50 HP., G.E. 220/440 or 550 v., 3 ph. 60 cy., 1755 to 18 rpm., splash proof, ball bearing.

PORTABLE COMPRESSOR

1—315 CFM Ingersoll Rand portable 100 lb. pres. driven by 106 HP Waukesha Oil Engines, 860 rpm.

FOR SALE OR RENT

WRITE, WIRE OR PHONE YOUR ELECTRIC NEEDS—SEND FOR STOCK LIST. LIST YOUR IDLE EQUIPMENT WITH US

Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.

GLOW ELECTRIC CO.

SQUIRREL CAGE MOTORS

HP	RPM	Volts	Make
750	900	6600	Westgh.
400	1200	440	GE-I-17
350	3550	2200	Westgh.-CS
350	514	440	GE-I
300	900	440	GE-I-17
250	600	2300	Triumph
225	514	440	GE-I-14
200	490	2200	GE
200	600	440	Westg'h-CS
150	600	2200	GE
125	1200	440	Century
125	340	220	A-C
100	1800	2300	Burke
85	3600	2200	GE
75	1800	220/440	GE-K5058
75	900	2300	GE
75	720	2300	Wagner
60	3600	2300	GE-KT
60	1800	2300	GE-FTR
60	1200	220/440	GE-K5053
50	3600	440	R. & A.
50	1800	220	GE-KT
50	900	220	GE
50	720	2300	Wtg.-CS
40	900	2300	Wtg.-CS
40	900	220	Lincoln
40	720	440	GE-KT
30	1200	dual	Master
30	900	220	Al.-Ch.-AR, fr. 220c
30	900	220	Wagner(BB-Torque)
30	720	220	GE-HJ
30	514	440	Stanley
25	3600	dual	L-A
25	1800	dual	GE
25	1200	220	Wesche
25	900	440	GE
25	900	220	Westgh.-CS
25	720	220	Wagner
25	600	440	GE-I
20	3600	dual	GE
20•	1800	220/440	Master
20•	1800	220/440	Wesche
20	1200	440	Al. Ch.
20	900	440	Wtg.-CCL
20	600	220	GE-KT

ENCLOSED SQUIRREL CAGE

HP	RPM	Volts	Make
125•	1200	440	GE-TE-FC-BB
75	1200	2200	GE-TE-FC-BB
60	900	440	GE-TE-FC-BB
30	1200	440	Wagner
30	900	440	Reliance, TE-FC-BB
20	3600	dual	Delco-TE-FC-BB
20	1200	440	Wagner
20	900	440	GE-TE-FC-BB
15	1800	dual	Delco
15	1200	220/440	Delco-TEFC-BB
15	900	440	GE, TE-FC-BB
10	1200	440	GE-TE-FC-BB
7½•	1800	dual	Wagner-TEFC-BB
7½•	1800	dual	Master-TEFC-BB
7½	1200	dual	GE-HI Slip-TEFC-BB
7½	1200	dual	Delco
7½	1090	220/440	GE-HI Slip
7½	900	dual	Delco-TEFC-BB
5	3600	dual	Delco-TE-FC-BB
5•	1800	dual	Master-TEI C-BB
5	1800	220	Wagner TE-BB
5•	1200	dual	GE-TEFC-BB
3	3600	dual	Delco, TE-FC-BB
3	1800	dual	Delco-TEFC-BB
3	1200	dual	Rei-TEFC-BB
3	900	dual	Delco
2	1800	dual	Delco-TEFC-BB

•New Motor

ENCLOSED SQUIRREL CAGE—Cont'd.

HP	RPM	Volts	Make
2	1200	220	GE-TE-BB
2	900	220	Wagner-TE-BB
1½	900	dual	Delco-TEFC-BB
1½	1800	dual	L. Al-TE-BB
1½	1200	dual	Delco-TEFC-BB
1	3600	220	Haskins-TEFC
1	1800	dual	Master-TEFC-BB
1•	1800	dual	Delco-TE-BB
1•	1200	dual	Rel-TE-BB
¾	3600	4400	Delco-TE
¾	1800	dual	Wesche-TE-BB
¾	900	dual	Delco-TEFC-BB
½	1800	440	Delco-TE-BB
½	1800	dual	Delco-TE-BB
½	1200	220	Cr. Wh.-TE
¼	900	dual	Delco-TE
1/3	1800	440	Delco-TE

SLIP RING MOTORS

HP	RPM	Volts	Make
500	900	440	GE-3 Brg.
400	1200	2300	Al. Ch.
400•	514	2300	C-W, Short Shaft
375	1800	2300	Al. Ch.
350	900	2300	Westgh.
250	300	2300	Al. Ch.
235	1800	220	GE-I
75	1800	220	GE
75	900	440	Al.-Ch., ANY
60	1800	dual	Al. Ch.
60	900	2300	Burke
60	900	220	Wesche
50	1800	220	GE-MT
50	900	2300	Ridgeway
50	900	440	Wagner
50	720	440	Al. Ch.
40	1200	220	GE-MT-336
40	900	220	Wtg.-HP
40	720	2300	Wtg.-HP
40	720	220	Al. Ch.-ARY
40	600	2300	Al. CH.-ARY
40	600	220	Al. Ch.-ARY
40	450	220	Triumph-C
35	1200	220	Westgh.
35	900	220	Al. Ch.
35	900	2300	Ridgeway
35	720	220	GE
35	900	2200	GE
30	1800	2300	Wtg.-CW
30	1800	220	GE
30	1200	440	Wagner
30	1200	2300	Lincoln
30	900	220	GE-MT
30	900	2300	F-M
30	720	220	GE-I
30	600	220	F. Morse-BV
25	1200	220/440	Watson-KH
25	600	220	Watson

•New Motor

VERTICAL MOTORS

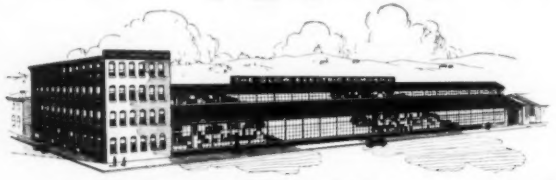
HP	RPM	Volts	Make
200	1200	440	Al. Ch.-SR
150	1200	2200	GE-I-SR
150	1200	440	GE-Cage
125	1200	2300	Al. Ch.-SR
125	1200	2300	Al. Ch.-Cage
100	1200	440	GE-Cage
100	1200	440	Wagner
75	1200	2300	Westgh.-Cage
75	1200	2200	GE-Cage
75	380	220	Ideal-Cage
60	1800	230 D.C.	GE
60•	1200	440	Al. Ch.-Cage

VERTICAL MOTORS—Cont'd

HP	RPM	Volts	Make
50	1200	2200	Wtg.-Cage
50	600	440	Al. Ch.-Cage
40	1200	440	Westgh.-F
40	1800	220	GE-Cage
40	1700	230 D.C.	GE
40	1200	440	Wtg.-SR
40	1200	2200	Westgh.-BB-Cage
35	1200	2300	Al. Ch.-Cage
35	450	440	GE-Cage
30	1200	dual	Wtg.-Cage
25•	1550	230 D.C.	GE
25	1200	2200	GE-Cage
25	850	230 D.C.	Wtg.
20•	1800	440	Al. Ch.
20•	1200	440	Al. Ch.-Cage
20	800	230DC	GE-RC
15•	1800	440	Al. Ch.-Cage
15	1750	110 D.C.	Wtg.
15	1150	230 D.C.	GE
15	600	440	Al.-Ch.
12½	900	220	L. Al.-Cage
10	3400	230 D.C.	Wtg.
7½	1800	500 D.C.	Peerless
7½	900	440	Burke
7½	700	230 D.C.	GE
6	850	110 D.C.	Rel.
5	1400	230 D.C.	R. & M.
5	600	440	GE-Cage
4	1650	110 D.C.	Watson
3	3600	dual	Delco
5	1700	230 D.C.	Watson
3	1200	dual	Wtg.-Cage

SYNCHRONOUS MOTORS

HP	RPM	Volts	Make
3000	720	4800	GE-ATI
1015	500	2200	Wtg.-25 cycle
710	720	13200/6600	GE
500	514	440	GE
435	720	2300	GE TYPE ATI
320	900	2300	GE-ATI
250	225	2200	GE-TS
220	600	2300	GE-ATI
200	720	440	GE-TS
200	225	2300	Wtg., rotor & stator only
160	300	440	GE-ATI
150	1800	2200	GE
150	1800	220	GE-ATI, Single Bearing
150	720	440	Westgh.
120	225	220	E-M, rotor & stator only
113	164	2300	GE
95	1200	220	Burke
75	1200	220	Westgh.
75	900	2300	GE-ATI-7552
60	360	2200	GE, rotor & stator
50	1200	440	Wagner
50	900	220/440	Westgh.
50	720	440	GE-TS
50	360	440	GE, rotor & stator
30	900	440	Wagner
30	600	550	GE, rotor & stator
30	450	dual	Wtg., rotor & stator
30	360	550	GE
30	327	220	E-M, rotor & stator
25	1800	220	Wagner
25	450	220	E-M, rotor & stator
25	300	220	Ideal
20	1200	440	Wagner
20	900	220	Wtg.
20	600	220	E-M, rotor & stator
15	1800	220	Wagner
15	1200	440	Wagner
10	1800	220	Wagner
10	1200	220	Wagner



SPECIAL SUB-STATION

G. E. Double ended Lead Center, Unit Sub-Station complete with:

2—Pyranol Filled, indoor type transformers each rated 1000 KVA, 13800 volts primary, 460 volts secondary, 3 phase, 60 cycle, and each having a liquid filled disconnect switch.

3—G. E., type AL-2, 1600 amp., 50000 amp. RMS, Air Circuit Breakers.

12—G. E., type AE1B, 600 amp. Air Circuit Breakers of draw out type.

Switchgear latest type metal clad.

D. C. MOTORS

115 Volts

HP	RPM	Description
25	750	GE-MPC
60	1200	Star
35	975	Northern
30	1800	F-M
30	200/600	Sprague
25	1150	Triumph
25	750	GE
20	700	Triumph
20	500/1500	GE-RF11
20	400/1200	GE-RLC fr. 202A
18	600	Sturtevant MP8
15	1200	J. & L.
15	1000	GE-CE
15	975	F-M
15	725	Westgh.-8 fr 6
12½	1150	GE-RC29
12	1075	J. & L.
12	530	Westgh.-SK-113
10	3450	Imperial
10	1800/3400	Star, SB-5
10	1200	J. & L.-CI
10	650	J. & L., type CI
10	400/1800	Watson-BW15B

D. C. GENERATORS

125 Volts

KW	RPM	Description
500	750	GE-MCF
300	1500	GE-CC
200	900	GE-MPC
200	800	GE-DMC
100	1000	WE-DLC
100	900	C-W-CCD
80	400	J. & L.-G
65	1100	W-E, type ELC-7
55	1000	GE-Type TD
40	600	J. & L.-F Fed. Type
35	1165	GE-DLC
31.25	1400	Westgh.-SK-single bearing

D. C. GENERATORS

230 Volts

KW	RPM	Description
400	1200	Westgh.
200	1200	GE-MPC
200	375	J. & L.-type K
175	450	Westgh.
125	1400	Westgh.-SK-130L
80	1050	GE-DLC
75	700	Allis-Chalmers-E180
50	1200	Al. Ch.-E-127
35	1800	GE-RC
30	900	Electro Dynamic-158
30	300	Triumph
22½	755	Westgh.-SK
18	300	Burke
15	350	Westgh.-SK

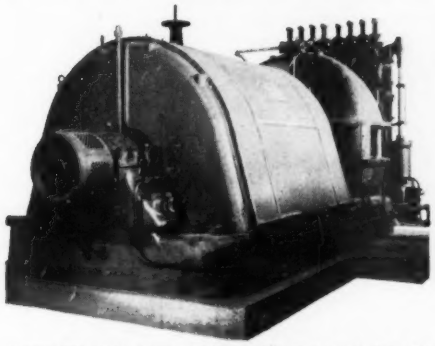
AC & DC MOTORS • GENERATORS • PUMPS
SYNCHRONOUS MOTORS • CONTROL EQUIPMENT
MOTOR GENERATOR SETS • ELECTRIC EQUIPMENT
STEAM ENGINE GEN. SETS • SLIP RING MOTORS

927 HARRIET ST.
PHONE MA. 3024
CINCINNATI 3, OHIO

FOR IMMEDIATE DELIVERY

6250-KVA. G.E. TURBINE-GENERATOR

A HIGH GRADE MACHINE



Above 6250-KVA., General Electric, Just Purchased, is in A1 Condition. Complete, 200#-psig, 2300/4160-v, 3600-RPM., with 7000 sq. ft. Condenser with Auxiliaries.

TURBINE-GENERATORS IN STOCK: Below is a Partial List:

Ref. No.		Ref. No.		Ref. No.	
1	6250-KVA. G.E., 2300/4160, 200# Cond.	7	1875-KVA. G.E., 250#-psi. Cond.	13	425-KVA. G.E. (2), 450#, Modern
2	4375-KVA. G.E., Rebuilt, New Coils.	8	1875-KVA. A.-C., REBUILT, Like New.	14	625-KVA. G.E., 200#-psi., Cond.
4	3125 KVA. G.E., 250#, Complete Unit.	9½	937-KVA. G.E., Cond., Rebuilt	15	375-KVA. G.E., 300#-psi., Cond.
5	3125-KVA. Westinghouse, 250#, Sur. Cond.	10	937-KVA. Allis-Chalmers, Cond. 480-v.	16	500-KW.—Several Available.
		12	625-KVA. G.E., Cond., 200#-psi.		

20 New Surface Condensers in Stock; New Auxiliaries Also. 50% Saving Over Today's Mfrs. Prices. Immediate Delivery.

DIESEL ENGINES IN STOCK

5—1600 HP, OP Fairbanks-Morse Engines, equipped with NEW (Unused) 1250 KVA Generators, all attachments for a complete installation.

4—1200 HP, OP Fairbanks Diesel Engines direct connected to 900 KW Elliott Generators, 720 RPM, 375 V.

3—100 KW Westinghouse AC Generator Sets, 1200 RPM, 440 V, being GM, Model 3-268-A.

Several 300 KW 448 HP, GM, Baldwin and Westinghouse, 120/240 V. DC Engine Generator.

BOILERS

Comb. VU, 600#, 750° FTT, complete with all trim. Immediate Delivery.

2—4000 HP, B & W 300#.

2—3000 HP, B & W 300#.

4—B & W 450#.

All complete with all trim.

2—400 HP, 250# Used, No. 1 shape Combustion Engineering Type Under Feed Stokers.

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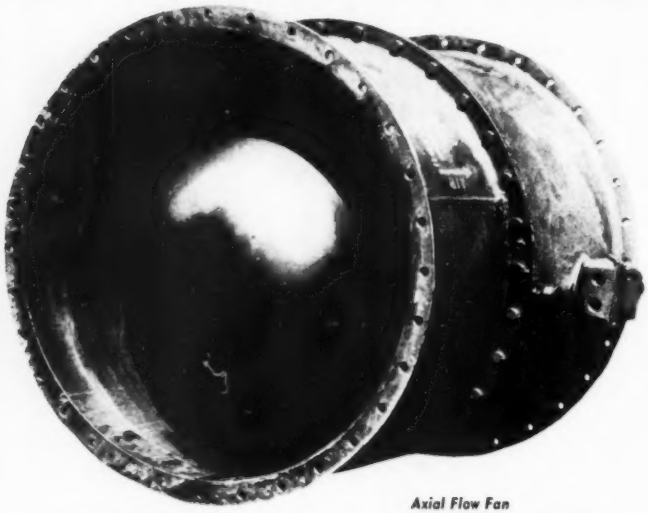

Axial Flow Fan

AXIAL FLOW FANS

20,000 CFM 3" S.P. 3/60/450 Sturtevant
12,000 CFM 3" S.P. 3/60/450 Clarage
10,000 CFM 3" S.P. 3/60/450 Buffalo
5,000 CFM 3" S.P. 3/60/450 LaDel
3,000 CFM 3" S.P. 3/60/450 Sturtevant
35,000 CFM 1" S.P. 230 V DC Wing

BOILERS

10—Cleaver-Brooks, 2000# steam pr. hr. 35# press.
3—Cyclotherm 3000 pounds steam per hour, 125# press.
Wheeler 30,000# steam/hr., 435#.
1—Express Boiler, modified D type, Foster
2—Type "D", water tube, Foster Wheeler, 15000# steam/hr., 275# press.

DISTILLING PLANTS

2—8000 gallons per day Griscom Russell, Soloshell double effect, low pressure.
10—2000 gals. per day Kleinschmidt vapor compression distiller mfd. by Badger.
1—750 gals. per day, same as above.

BLOWERS—AIR PUMPS

8—Blowers, Roots Connersville, size 16x18, serial No. 14862, capacity 5000 CFM against 6 lb. sq. in. gg. pressure or 3450 CFM when creating 20" Hg vacuum, with 200 HP motors 3/60/2200 (mfd. 1942). Also available: 1 R.C. Blower, size 20x23 with 350 HP motor.
1—Air Pump, Ingersoll Rand, type FS548, 5500 CFM, discharge press. 24.22 abs., intake press. 20.61 abs., with 125 HP motor 3/60/2300 (mfd. 1942).
1—Air Pump, Ingersoll Rand, type FS548, 6690 CFM, discharge press. 20.86 abs., intake press. 17.10 abs., with 150 HP motor 3/60/2300 (mfd. 1942).
1—Blower, Buffalo, size 60, type R, with 150 HP motor 3/60/2200.

SPECIAL

2—BRAND NEW 200 KW turbogenerators, 3 phase, 60 cycle, 450 volts, turbines 540# p.s.i.g., 1# abs. exh. press., mfd. by Westinghouse.

CONDENSERS

(Most are new)

No.	Sq. Ft.	Make	Passes	Tubes
4	3300	Str. Wells	2	Alu-Brass ¾"
1	2200	Alco	2	Cu Ni ⅝"
4	1050	Conseco	2	Cu Ni ⅝"
1	750	Bethlehem	2	Brass ⅝"
30	400	All. Chalm	2	Brass ⅝"
4	300	Wheeler	2	Cu Ni ⅝"
8	155	Conseco	2	Brass ¾"
44	349	Luboil Coolers		Cu Ni ⅝"

MOTORS

6—3800 HP 1700 V 257 RPM G.E.
5— 700 HP 2300 V 128 RPM
1— 50 HP 220 V 575/1150 Fairbanks Morse
8— 20 HP 440 V 1760 RPM G.E.
8— 60 HP 440 V 1780 RPM G.E. gear motors, shaft 427 RPM
8— 40 HP 440 V 1775 RPM G.E. gear motors, shaft 561 RPM
D.C.
1500 HP 525 V DC 600 RPM W'se.
667 HP 374 V DC 1300 RPM Elliott
444 HP 250 V DC 900 RPM Elliott
222 HP 230 V DC 3050 RPM W'hse.
15 HP 120 V DC 500 RPM Diehl

GENERATORS

1200 KW 525 V DC 750 RPM All. Chalm.
1075 KW 375 V DC 750 RPM Elliott
700 KW 240 V DC 500/720 Elliott

TURBO-GENERATORS—A.C.

1—1000 KW All. Chalmers 3/60/600, 3600 RPM, cond., 140# steam press.
2—250 KW G.E. type ATI 3/60/450, 1200 RPM, cond.
1—200 KW G.E. type ATI 3/60/450 1200 RPM, cond.
2—200 KW Westinghouse, 3/60/450, 1200 RPM cond. (New).
6—200 KW G.E. type ATB 3/60/450, 1200 RPM cond. and non-cond.
2—132 KW G.E. type ATB 3/60/450, 1200 RPM, cond.

TURBO-GENERATORS—D.C.

KW	Volts	Winding	Speed	Type
2—375	180/240	Shunt.	1200	non-cond.
5—300	120	Compd.	1200	cond.
1—300	240	Compd.	1200	cond.
2—250	240	Compd.	1200	cond.
12—150	120	Shunt.	1200	cond.
12— 60	120	Stab. Sh.	1800	cond.
3— 25	120	Stab. Sh.	1200	cond.

STEAM TURBINES

All New

1—110 HP 250# steam, 10# exh. 1200 RPM Sturtevant mfd. 1943
10—56.5 HP, 300-475# steam, 10-15# exh. 1225-1600 RPM, Sturtevant, mfd. 1944

REDUCTION GEARS

4—1800 HP 2.41:1
10— 900 HP 2.48:1
10— 25 HP 20:1
10—20 HP 41:1
10—11 HP 39:1
10—10 HP 1750:63
7—Waterbury Hydraulic type K, size 35.5 and 2a

DIESEL ENGINES

HP	MAKE	MODEL	RPM	CYCLE	YEAR
1800	General Motors	16-2585	900	4	1943
1600	Fairbanks Morse	38D8⅛OP	720	2	1944
1600	Hamilton	RB99-D.A.	700	2	1944
1600	General Motors	16-278A	720	2	1944
1200	General Motors	12-278A	750	2	1944
1200	General Motors	16-184A	1800	2	1943
900	General Motors	12-567ATL	750	2	1942/44
500	Superior	6-cyl.	514	4	
300	Fairbanks Morse	38-O/P	1200	2	1936
150	Superior	GDB-8	1200	4	1942/44
90	Hercules	DWXD5	1800	4	1943

DIESEL GENERATOR SETS

AC	200 KW	3/60/450	1800 RPM	General Motors	8-268A	1943 rebuilt
	100 KW	3/60/450	1200 RPM	General Motors	3-268A	1943 rebuilt
DC	1200 KW	525V	750 RPM	General Motors	16-278A	1943
	650 KW	240V	750 RPM	General Motors	12-567	1943
	290 KW	120/240	1200 RPM	General Motors	8-268A	1944
	125 KW	120/240	600 RPM	Superior	VDMB	1944
	100 KW	120/240	1200 RPM	Superior	GDB-8	1942/44
	100 KW	120/240	1200 RPM	General Motors	3-268A	1943/44
	60 KW	120V	1200 RPM	Buda	909	1942
	10 KW	120V	1200 RPM	Hercules	DOOD	1943

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PUMPS . . . FANS . . . BLOWERS . . . SPEED REDUCERS

PARTIAL STOCK LISTING—WRITE, WIRE OR PHONE YOUR REQUIREMENTS

250 KW Allis-Chalmers M-G Set, DC 120/240V, output, 363 H.P. Synch. Motor, 3/60/440V, 1200 RPM, AC & DC panels, late model.

M-G SETS

KW	Mfr.	Input V	Output V
200	Ridgeway*	2300/4000 AC	550 DC
200	Gen. Elec.	220/440 AC	125/250 DC
150	Cr. Wheeler*	220/440 AC	250 DC
105	Century b.b.	220/440 AC	70 DC
100	Gen. Elec.*	220/440 AC	250 DC
100	Gen. Elec.*	220/440 AC	125 DC
75	Star b.b.*	220/440 AC	250 DC
75	Star b.b.	240 DC	230/460 AC
75	Gen Elec. (2)	220/440 AC	125 DC
50	Whse.	220/440 AC	250 DC
50	Gen. Elec.	220/440 AC	250 DC
50	Gen. Elec.	220/440 AC	125 DC
40	Gen. Elec.	220/440 AC	120 cycle
40	Northw'n Conv.	220 AC	230 DC
35	Gen. Elec.	220/440 AC	40 DC
30	Gen. Elec.	220/440 AC	250 DC
30	Elec. Prod.*	220/440 AC	50 DC
20	Whse.	220/440 AC	250 DC
15	Gen. Elec.	220/440 AC	125 DC
10	Allis Ch. (2)	220/440 AC	250 DC

*Synch. motor drive.

D. C. MOTORS

H.P.	Mfr.	Type	Volts	Speed
150	Cr. Wheeler b.b.	TEFC	230	800
100	Whse.	SK181	230	450/900
100	Gen. Elec.	C	230	575/1000
75	G.E. New b.b.(2)	CDM	230	1755
75	Cr. W. New b.b.	CMC	230	1150
75	Allis Ch.	E	230	500
75	Whse.	S13L	115	570
75	Gen. Elec.	BRC	115	1150
75	Northw'n	K20	230	1750
60	Gen. Elec.	RC36	230	650
60	Elec. Dyn.	25-S	230	450/900
60	Whse.	SK	230	1700
60	F. Morse b.b.	DH	230	1150
50	Gen. Elec.	RC33	230	1100
40/60	Whse. (2)	SK170	230	500/1000
40	Sprague dyna.	LC	230	750/2000
35/50	Gen. Elec.	CD123	230	575/1150
35	Ideal	DV350	230	400/1200
30	Whse.	S-7	115	900
30	Gen. Elec.	RC31B	230	1150
25	Gen. Elec.	RC31	230	1150
25	Sprague dyna.	LC	230	750/2000
25	Chand'son(4)	C13	115	850
25	Gen. Elec.	CD865	230	1750
20	Gen. Elec.	RT12	230	400/1600
20	Whse.	SK93	230	1150
20	G.E. b.b. NEW	CDM83	115	1750
20	Gen. Elec.	RC11	115	1150
20	Reliance	T	230	850
20	Gen. Elec.	DC55	230	1150
15	G.E. b.b. NEW	CDM67	115	1750
15	Whse.(5)	SK90	230	825
15	El. Dyn. b.b. (2)	326	230	1750
15	Whse. (2)	SK80L	230	1150
15	Star b. b. (4)	SQ	230	1200

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
150	Cr. Wheeler b.b.	TEFC	250	1200
105	Century b.b.	1500amp.	70	1200
100	Gen. Elec.	RC17	125	1200
100	Gen. Elec.	C	250	750
75	Allis Ch.	E	250	750
75	Whse.	S	125	900
75	Cr. Wheeler b.b.	CCD	250	1450
75	Gen. Elec. (2)	RC36	125	1200
50	Gen. Elec.	RC36	250	1450
50	Gen. Elec.	RC	250	1250
40	Gen. Elec.	RC32	250	1450
30	Elec. Prod.	BF	50	1150
30	Gen. Elec.	RC	250	1500
20	Reliance	T	250	1150
15	Star b. b. (3)	late	250	1750

EXPLOSION PROOF MOTORS

from 1 to 20 H.P. ..... std. speeds

SPECIAL—Gen. Elec. Freq. Changer
300 H.P. 25 cycle synch. motor 2200 V. with 250 KVA 60 cycle gen. 2200V. 750 RPM exciter & control panels—low price for quick action!

A. C. MOTORS—25 CYCLE

H.P.	Mfr.	Type	Volts	Speed
150	Whse.	HF	440	500
150	Gen. Elec.	IK-16	440	750
50	Allis Ch.	ANY	440	750
50	G.E. int.	MTC5337	440	750
50	G.E.	I-K	440	750

A. C. GENERATORS—60 CYCLE

KVA	Mfr.	Type	Volts	Speed
625	Gen. Elec.	ATB	2300	450
500	Allis Ch.	3 brg.	240/480	360
375	Whse.	G	240/480	900
300	Gen. Elec.	ATB	240/480	720
250	Whse.	G	2300	600
200	Gen. Elec.*	ATB	240/480	600
187	Gen. Elec.	ATB	240/480	900
156	G.E. 1 brg.	ATB7558	240/480	1200
150	Gen. Elec.	ATB	2300	450
150	Gen. Elec.	ATB	240/480	900
125	Gen. Elec.	ATB	240/480	300
100	Whse.	G	2300	900
100	Gen. Elec.	ATB	240/480	1200
56	Gen. Elec.	ATB	240/480	1200
56	Gen. Elec.	ATB	240/480	900
50	Allis Ch.	B	240/480	1200
25	L. Allis	ALT	240/480	1200
25	Whse. b.b.	1 ph.	120/240	900
12½	Whse. b.b. NEW		240	1200

A. C. MOTORS—SLIP RING

3 Phase 60 Cycle 220 or 440 Volts

Qu.	H.P.	Mfr.	Type	Speed
1—	600	Gen. Elec.	I-M	360
1—	450	Whse. 2200 V.	CW	600
2—	300	Allis Ch. 2200 V.	ANY	720
1—	300	G.E. 2200 V.	I-M	1800
1—	300	Whse. 2300 V.	CW	600
1—	200	Cr. Wheeler	SR	600
1—	200	Gen. Elec.	IM-17A	450
1—	150	G.E. 2200/4000 V.	I-M	1200
1—	150	Allis Ch.	ANY	600
1—	100	Allis Ch.	ANY	1800
1—	100	Al. Ch. b.b. NEW	ARY	600
1—	100	Allis Ch.	ANY	720
1—	100	Whse. int. 2200 V.	C1856C	600
1—	100	Whse. int.	CI-756A	720
2—	75	Gen. Elec.	IM-14	720
1—	75	G.E. int.duty	MTC5342	900
1—	75	Ideal int.	AVE	1200
1—	75	Gen. Elec.	MT558	600
2—	75	Gen. Elec.	IN-14	600
1—	75	Gen. Elec.	MT337	1800
2—	50	Allis Ch.	ANY	900
1—	50	Howell	SR437	1200
1—	50	Fair. Morse	BV	720
1—	50	Gen. Elec. int.	ITC	600
1—	50	Whse. int.	CI	600
1—	50	Gen. Elec.	I-M	720
1—	40	Gen. Elec.	MT336	900
1—	37	G.E. int.	ITC	600
1—	30	Gen. Elec.	OMT336	1200
1—	30	Gen. Elec.	MT346	600
1—	30	Gen. Elec.	MT326	900
2—	25	Gen. Elec.	MT332	900
1—	25	Triumph	SR	1200
1—	25	Gen. Elec.	I-M	600
1—	20	G.E. int.	MTC5312	900
1—	20	Gen. Elec.	MT326	900
2—	20	G.E. int.	MTC5302	1200
1—	15	P & H b.b. int.	W7	1200
14—	10	Reliance New b.b.	AW-324	1800

A. C. MOTORS—SYNCHRONOUS

H.P.	Mfr.	Type	Volts	Speed
450	Whse.		220/440	900
300	Whse.	G	2200/440	600
250	Ideal	2BC-M4	2200	450
220	G.E. 3 brg. .8 PF	ATI	220/440	600
200	G.E. .8 PF	ATI	220/440	900
150	Gen. Elec. .8 PF	ATI	2300	450
150	Gen. Elec.	ATI	220/440	300
125	Whse.	G	2300	900
125	G.E. splprf. .8 PF	TS955	220/440	1200
100	American b.b.	YGH	220/440	900
60	Gen. Elec. .8 PF	ATI	220/440	900

A. C. MOTORS—SQUIRREL CAGE

3 Phase 60 Cycle 220 or 440 Volts

Qu.	H.P.	Mfr.	Type	Speed
1—	300	Gen. Elec.	IK-16	1200
2—	200	Reliance b.b. NEW	C8085	1800
1—	200	Allis Ch.	AN	1200
1—	200	L. Allis 2200/3800 V.	OGK-144	900
1—	150	Allis Ch. 2200 V.	b.b.	720
1—	150	Reliance b.b. NEW	14C8085	720
1—	150	Whse. 2200 V.	CS771-1C	1800
1—	150	Reliance b.b. NEW	B8085	1200
1—	150	Gen. Elec.	IK-15	900
1—	150	Reliance b.b. NEW	B8085	900
1—	125	Reliance b.b. NEW	C8085	1200
2—	125	Allis Ch. 2200 V.	AN	1200
1—	125	Gen. Elec.	IK-16	450
1—	125	Cont. 2200 V. b.b.	SC	1800
2—	125	Rel. TEFC NEW	B8085	1800
1—	100	Gen. Elec.	I-K	1800
5—	100	Allis Ch. 2200 V.	AR226	1200
1—	100	Reliance b.b. NEW	C8085	900
1—	100	Elec. Mashy.	b.b.	1200
1—	100	Rel. TEFC NEW	C8085	1200
1—	100	G.E. b.b. NEW	K5048	1800
1—	100	Cont. TEFC	NP682	1200
1—	75	Gen. Elec.	I-K	1200
1—	75	Gen. Elec.	I-K 14	720
1—	75	Reliance b.b. NEW	C8084	900
1—	75	Gen. Elec.	KT552	900
1—	75	Reliance TEFC NEW	C8084	1200
1—	75	Reliance b.b. NEW	C805	1800
1—	75	Gen Elec.	KT329Y	3600
2—	75	Reliance b.b. NEW	C805	1200
1—	60	Gen. Elec.	KT346	900
2—	60	Reliance b.b. NEW	B804	1800
2—	60	Rel. TEFC NEW	C805	1200
2—	60	Reliance b.b. NEW	C804	1200
2—	60	Whse. H. T.	CS504	1800
1—	60	Wagner b.b.	RP444	3600
1—	60	Allis Ch. 4000/2200 V.	AR823	1800
1—	50	Whse. b.b. NEW	CS4058	1800
1—	50	G.E. 3 phase	I-Q	900
2—	50	G.E. NEW b.b. HT	KG405	1800
2—	50	Reliance b.b. NEW	C445	1200
2—	50	Gen. Elec.	KT336	1200
1—	50	Gen. Elec.	KT342	900
1—	50	Whse. hielip	WL607	900
2—	40	Gen. Elec.	KT527	1800
1—	40	Al. Ch. 3 speed	ARX 900/600/450	
5—	40	Gen. Elec.	KT336	900
2—	40	Reliance b.b. NEW	C404	1800
2—	40	Rel. TEFC NEW	C445	1200
2—	40	G.E.	KT532	1200
2—	35	Gen. Elec.	I-K	720
2—	30	Howell b.b. speed	SC	1800
2—	30	G.E. NEW b.b.	K365	1800
2—	30	G.E. NEW hitorq	KG365	1800
2—	30	G.E. TEFC b.b.	K404	1800
1—	30	Gen. Elec.	I-K	900
1—	30	Gen. Elec.	KT336	720
1—	30	Wagner	22T8P	900
1—	30	Whse.	CS946	900
2—	30	Reliance b.b. NEW	C405	1200
2—	30	Reliance TEFC NEW	C444	1200
1—	30	Cr. Wheeler b.b.	SC30Y	1800
2—	25	Gen. Elec.	KT326	1200
2—	25	Rel. TEFC NEW	C444	900
3—	25	Reliance b.b. NEW	C364	1800
2—	25	Reliance TEFC NEW	B365	1800
2—	25	Reliance b.b. NEW	C404	1200
2—	25	Reliance TEFC NEW	C405	1200
2—	25	Whse. NEW spl. b.b.	CS365	1800
3—	25	Whse.	CS646	900
2—	25	Gen. Elec.	I-K	600
1—	20	Reliance b.b. NEW	C404	900
1—	20	G.E. TEFC b.b.	K404	1200
4—	20	Reliance b.b. NEW	C364	1800
2—	20	L.A. NEW exp. prf.	EX364	1800
2—	20	Whse. NEW b.b. spl.	CS364	1800
2—	20	Gen. Elec.	KT312	1200
1—	20	Whse.	CS	1200
2—	20	G.E. NEW b.b.	K365	1200
2—	20	Diehl TEFC NEW	INF364	1800
2—	20	Century b.b. 4 speed	SC594	1800
4—	15	G.E. NEW b.b.	K324	3600
2—	15	Whse. NEW TEFC	CS326	1800
1—	15	Gen. Elec.	KT312	900

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TURBINE UNITS

1—9375 KVA Cond. 50 cy. 13800 V. 600-lb. 825 deg. PTT. Surface condenser & boiler. NEW.
1—5000 KVA G. E. Non-C. 60 cy. 13200 V. 600-lb.
1—3750 KVA West. Cond. 60 cy. 2300 V. 200-lb. Surface Condenser.
1—3125 KVA Worthington Non-C. 60 cy. 2300 V. 150-200-lbs.—40-lbs. BP.
1—1875 KVA G. E. Non-C. 60 cy. 480 V. 175-200-lbs. 15-lbs. BP.
1—1563 KVA G. E. Ext. cy. 2300 V. 400-lbs.
1—1250 KVA DeLaval Non-C. 60 cy. 2300 V. 250-lbs.
1—1250 KVA Allis Cond. 60 cy. 2300 V. 150-200-lbs.
1—1250 KVA West. Non-C. 60 cy. 2300 V. 275-lbs.
1— 625 KVA Terry Non-C. 60 cy. 240/480 V. 135-lbs. 5-10-lbs. BP.
1— 187 KVA G. E. Non-C. 60 cy. 480 V. 375-lbs. 100-lbs. BP.
1— 125 KVA West., Non-C. 60 cy. 240/480 V. 150-lbs., 5-lbs. BP.
1— 25 KW Allis Non-C. DC 125 V. Exciter Dual drive turbine & motor.

BOILERS

2—600 HP B. & W. 350-lb. Sectional header
2—500 HP B. & W. 200-lb. Stokers
2—508 HP Casey Hedges Bent tube
1—507 HP Comb. Engr. 400-lb. 620 deg. TT. Oil
2—200 HP Erie Economic 125-lb. Stokers
1—180 HP Frost 200-lb. Return tubular

STEAM ENGINE UNITS—60 Cy.

1—1125 KVA Nordberg Uniflow, 480 V.
1— 450 KVA Ames Uniflow, 2300 V.
1— 450 KVA Skinner Uniflow, 480 V.
1— 312 KVA Skinner Uniflow
1— 150 KVA Ames Uniflow, 220 V.
1— 125 KVA Ames Uniflow, 2300 V.

D. C. STEAM ENGINE UNITS

2—750 KW Skinner Uniflow 250 V.
1—300 KW Skinner Uniflow 275 V.
1—275 KW Ames Vertical Uniflow 250 V.
1—200 KW Skinner Uniflow 250 V.
1—200 KW Skinner Uniflow 125 V.
1—100 KW Skinner Uniflow 230 V. 3 wire

DIESEL ENGINE UNITS

2—1600 HP Fair. Morse 60 cy. 2300 V. NEW gen.
1— 720 HP Amer. Loco. 240 V. DC
1— 625 HP Worth. 240 V. 60 cy. gen.
1— 600 HP Fair. Morse 2400 V. 60 cy.
1— 400 HP DeLaVergne 2400 V. 60 cy.
1— 375 HP Worth. 240 V. 60 cy. gen.
2— 240 HP Fair. Morse 2400 V. 60 cy.
1— 150 HP Gen. Motors 3-378A-60-3-480
2— 133 HP Murphy 240 V. 60 cy.

SYNCHRONOUS MOTORS—60 Cy.

2—3000 HP G. E. 2300 V. 257 RPM
1—1400 HP G. E. 4150 V. 514 RPM
1— 880 HP G. E. 6600 V. 514 RPM
1— 600 HP G. E. 440 V. 360 RPM
2— 500 HP E. M. 2200 V. 514 RPM
1— 400 HP E. M. 440 V. 600 RPM
1— 350 HP G. E. 440 V. 900 RPM
1— 300 HP G. E. 2300 V. 600 RPM
1— 300 HP West. 2300 V. 900 RPM
1— 250 HP West. 600 V. 180 RPM
1— 250 HP G. E. 550 V. 400 RPM
1— 200 HP G. E. 220 V. 600 RPM
1— 100 HP G. E. 2300 V. 240 RPM (Super)

INDUCTION MOTORS—60 Cy.

1—8000 HP Cr. Wh. S/R 2200 V. 895 RPM
1—7200 HP S/R 11000 V. 750 RPM 25 cy.
1—1200 HP Al. Ch. S/R 2200 V. 440 RPM
1—1000 HP G.E. S/R 2200 V. 514 RPM
1— 600 HP West. S/C 4150 V. 1200 RPM
2— 450 HP West. S/C 4150 V. 360 RPM
1— 300 HP West. S/R 2200 V. 1770 RPM
1— 250 HP G. E. S/R 2200 V. 1800 RPM
1— 200 HP Cr. Wh. S/C 2300 V. 900 RPM
3— 200 HP E. M. S/C 480 V. 1800 RPM
1— 200 HP Cr. Wh. S/C 2300 V. 720 RPM. New.
1— 200 HP G. E. S/R 2200 V. 435 RPM
1— 150 HP Cr. Wh. S/C 440 V. 1800 RPM. New.
1— 150 HP Cr. Wh. S/C 440 V. 1200 RPM. New.
1— 150 HP Cr. Wh. S/C 440 V. 900 RPM. New.

MOTOR GENERATOR SETS

1—1200 KW G. E. 125/250 V. DC 60 cy.
2—1000 KW G. E. 600 V. DC 60 cy.
1—1000 KW West. 250 V. DC 60 cy.
1— 500 KW G. E. 250 V. DC 60 cy.
1— 200 KW G. E. 60 V. DC 60 cy.
1— 75 KW West. 125 V. DC 60 cy.
1— 75 KW Star 240 V. DC 60 cy.
1— 18 KW West. 60 V. DC 60 cy.

ROTARIES—60 Cy.

1—2929/3705 KW Gen. Elec. 225/285 V.
1—2925/2565 KW Gen. Elec. 225/285 V.
2—1500 KW Westinghouse 270 V.
1— 500 KW Westinghouse 250 V.

MERCURY ARC RECTIFIERS

2—4500 KW Ignitron 600 V. DC
1—1850 KW Ignitron 275 V. DC
2— 300 KW Ignitron 250 V. DC

FREQUENCY CHANGERS

1—12500 KVA G. E. 25/60 cy. 300 RPM
2— 3000 KVA West. 25/60 cy. 300 RPM
1— 2500 KVA G. E. 25/60 cy. 300 RPM
2— 1000 KVA G. E. 25/60 cy. 300 RPM
1— 560 KVA Al. Ch. 25/60 cy. 300 RPM

TRANSFORMERS—60 Cy.

1—2000 KVA G. E. 69000-13800/23900 Y, 3 ph.
3— 500 KVA G. E. 66000-13200/6600 V.
3—2000 KVA West. 66000-11000 V.
3—1000 KVA West. 66000-11000 V.
4—7500 KVA Al. Ch. 33000-13800 V. 3 ph.
3— 50 KVA G. E. 33000-2300 V.
6— 75 KVA Maloney 33000-2300/6900 V.
3—3750 KVA West. 26400/13200-2400 V.
6— 250 KVA West. 22000-2300/4150 V.
4— 450 KVA Al. Ch. 25410-44000—13200-23000 Y
3—1667 KVA Wagner 23000-575/2300 V. 25 cy.
2— 750 KVA G. E. 13200-480 V. 3 ph.
2— 200 KVA G. E. 11500-220/110 V.
3— 200 KVA Maloney 11000-2300 V.
3— 167 KVA G. E. 7200/12400 Y-240/480 V.
1—1500 KVA West. Auto 4000-2300 V. 3 ph.
1— 100 KVA G. E. 2300-575 V. 3 ph.
3 250 KVA Al. Ch. 2300-460 V.
3— 20 KVA West. 2200-575/287½ V.
3— 7½ KVA G. E. 600-120/240 V.
12— 15 KVA Standard 450-117 Delta
2—27½ KVA G. E. 440-220/110 V.

OIL CIRCUIT BREAKERS

1— 400 A. 73 KV. G.E. FHK 236 Outdoor
1— 600 A. 73 KV. G.E. FHK 0139 Outdoor
1— 400 A. 37 KV. West. GII Outdoor
2—1000 A. 23 KV. Kolman CB76 Outdoor
4— 600 A. 15 KV. G. E. FHK0138BS Outdoor

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1—333 KVA, Gen. Elec 33000 x 13200/6600.
2—500 KVA, Pittsburgh 33000 x 13200/6600.
3—400 KVA, Westinghouse, 13200 x 240.
2—200 KVA, Packard 2300 x 115/230.
3—200 KVA, Westinghouse, 2300 x 230/460.
2—150 KVA, Gen. Elec. 2300 x 115/230.
3—150 KVA, Allis Chalmers 2400 x 120/240.
2—150 KVA, Pittsburgh 2300 x 230/460.
2—150 KVA, Pittsburgh 2300 x 115/230.
4—100 KVA, Gen. Elec. 2300 x 115/230.
Other sizes in stock in various voltages.

TURBO GENERATORS

1—500 KW, 3 ph., 60 cy., 440 V., to Gen. Elec. Turbine No. 38937. With condenser, switchboard, etc. Very modern unit.
1—500 KW, 3 ph., 60 cy., Gen. Elec. non-condensing.
1—750 KW, Gen. Elec. automatic extraction.
1—1000 KW, Gen. Elec. with surface condensor.

MOTOR GENERATORS

1—105 KW, 1500 amp., 70 V., to 150 HP, 3 ph., 220/440 volt, 1165 rpm, ball bearing Electric Products Co. Set.

MOTOR GENERATORS (Cont'd)

1—1000 amp., 80 Volt, Burke with 3 ph. syn. motor.
1—75 KW, 250 volt, 1200 rpm, 3 ph., 60 cy., 440 volt syn. motor. Star. Elec.
1—50 KW, 250 V., Louis Allis to 75 HP, 220/440 V., 1-K, G.E.
1—15 KW, 250 V., Westgh. SK to 3 ph., type CS motor.

CAPACITORS

8—180 KVA, Westgh. interteen 3/60/460.
6—120 KVA, Westgh. interteen 3/60/460.
11— 90 KVA, Westgh. interteen 3/60/460.
3— 90 KVA, Gen. Elec. Pyranol 3/60/460.

MISCELLANEOUS

1—30 KW, .8 PF, Century to a Buda diesel, complete.
2—25 KVA, 1 ph., 60 cy., 120 or 240 V. Westgh. to 4 cylinder LeRoi engines with panels.
1—150 KW, 125 V. Cr. Wh. gen. to 4 cylinder vert. Ames st. engine
1—1000 HP, Gen. Motors Diesel engine to 600 KW, 500 volt, 750 rpm, Westgh. generator.

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65 ton Whitcomb diesel elec. locomotive.
30 ton Plymouth gasoline locomotive.
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25 ton Steel Stiffleg Derrick and Hoist.
2-450 HP Fairbanks Morse 300 KW diesel engine generator sets.
2500 KW General Electric 2300 volt condensing turbine generator set.
2-500 HP B&W 250 lb. Watertube Boilers.

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SPECIALS

6½x6½x4 Worthington VA 104 CFM 80 Lbs.
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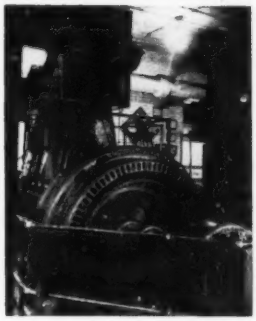

2—625 KVA Ames Vertical Uniflow Engine Sets, 60 cycle 220/440 volt, 300 RPM., direct exciters, switchboards. 150/175 lb. 2/3 lb. B.P. (Illustrated above). Units can be seen running in Philadelphia.

1—780 KVA Westinghouse Non Condensing Turbo, 3 phase 60 cycle, 2400 volt 3600 RPM, 125/150 lb., 5/15 lb. B.P. New 1931. Excellent condition—Philadelphia Warehouse Stock.

2—625 KVA General Electric Turbos, 3/60/2300/3600 RPM. Non Condensing, 150/175 lb., 5/15 lb. New 1938—Just Released—Inspection Phila.

1—500 KVA Westinghouse Non Condensing Turbo Geared Type, 6000/1200 RPM. 3 phase, 60 cycle, 240 volt, 125/150 lb. pressure, 5/10 lb. B.P. With new turbine rotor. Philadelphia Warehouse Stock.

1—375 KVA General Electric Non Condensing Turbo, 3/60/2300/3600 RPM. 175 lb., 5/10 lb. B.P. Blading Perfect. Philadelphia Warehouse Stock.

1—200 KVA Ridgeway Steam Engine 4-Valve type, Horizontal, 3/60/220. 125 lb., 5/10 lb. B.P. Philadelphia Warehouse Stock.

NEW O'BRIEN RED LINE AUXILIARY TURBO GENERATORS

Sizes 25 to 300 K.W. Geared and Direct Connected Types. 100 to 400 lb. I.S.P. 0 to 50 lb. B.P. A.C. & D.C.

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3—156 KVA Murphy Model ME 650 Diesel Generators with Paralleling Equipment. All Accessories. 3/60/220/1200 RPM. Radiator Cooled—Electric Start. Philadelphia Stock.

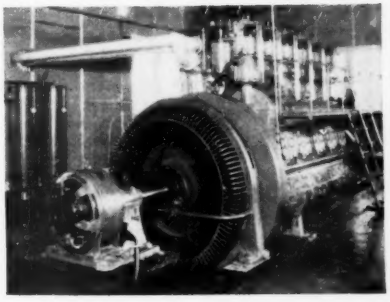
1—113 KVA Waukesha Diesel Generator Enclosed Portable Radiator Cooled. 3/60/220/440/1200 RPM. Used 400 hours. Same as New Guarantee. Philadelphia Stock. SPECIAL PRICE $6300.00.

1—62.5 KVA International Harvester Model UD 18 Diesel Set. Enclosed Radiator Cooled Portable or Stationary—Switchboard—Battery New 1945—Used 3 months. Same as New Guarantee. Philadelphia Stock. SPECIAL PRICE $3500.00.

20—New 37.5 KVA Chrysler Diesel Generators, 3 phase, 50 cycle 220/380 volt. Includes Radiator, Automatic Voltage Regulator. Boxed F.A.S. Philadelphia or New York. $3485.00 each. Philadelphia Stock.

4—25 KVA Westinghouse-LeRoi Gasoline Generators, Single Phase, 110/220 volt. Includes Radiator, Fuel Tank, Switchobard, Starting Battery. Used less than 1000 hours. LIKE NEW. Philadelphia Warehouse Stock.

1—NEW 6.25 KVA Sheppard Diesel Generator, Single Phase, 60 cycle, 110/220 volt. Philadelphia Stock. SPECIAL PRICE THIS UNIT $1300.00.



2—375 KVA Chicago Pneumatic 6 cylinder, 257 RPM Diesel Generators, 3/60/2300 volt. Includes All Accessories and Synchronizing Panels. Inspection on Foundations Maryland. (Illustrated above).

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O'BRIEN RED LINE Diesel Generators can be furnished for 50 or 60 cycle operation. Sizes 5 to 500 KW for Stock or Prompt Shipment—Advise Requirements.

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3 phase 60 cycle

25000 KVA G.E., 13800 volts, 400# steam.
6000 KVA (2) G.E., 4000 volts, 600# steam.
2250 KVA G.E., 2300 volts, 400# steam.
1560 KVA Allis, 240 volts, 180# steam, 5# extraction.
1250 KVA G.E., 4000 volts, 400# steam.
938 KVA G.E., 240 volts, 1250# steam.

BOILERS

90000# Per hour (4) Springfield, 300# steam, stoker fired.
37500# Per hour Heine, 400# steam, oil and gas fired.
15000# Per hour B & W, 700# steam, oil fired.
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NONCONDENSING TURBO UNITS

3 phase 60 cycle

5000 KVA G.E., 13800 volts, 600# steam, 150# extraction, 50# exhaust.
1875 KVA G.E., 480 volts, 200# steam, 20# exhaust.
600 KVA G.E., 480 volts, 130# steam, 50# exhaust.
375 KVA Kerr, 240 volts, 125# steam, 25# exhaust.
250 KVA (2) G.E., 480 volts, 150# steam, 15# exhaust.

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5000 KVA Penn., 12000/2400 volts.
4500 KVA G. E. 11000/480 volts.
3750 KVA Moloney, 4160/240/480 volts.
3500 KVA Westg., 33000/13800 volts.
3000 KVA Penn., 12000/2400 volts.
1000 KVA G.E., 33000/460 volts.

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3 phase 60 cycle

4500 KW (3) Allis, 600 volts DC, 13800 volts AC.
1750 KW Westg., 365 volts DC, 34500 volts AC.
500 KW Westg., 650 volts DC, 4400 volts AC.

MOTOR GENERATORS

3 phase 60 cycle

500 KW Westg., 125 volts DC, 2200 volts AC.
150 KW Westg., 250 volts DC, 2200 volts AC.
60 KW G.E., 125 volts DC, 440 volts AC.

ROTARY CONVERTERS

3 phase 60 cycle

3000 KW G.E., 250 volts DC, 13800 volts AC.
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Special Offerings

TURBO-GENERATORS

2—New 4000 KW Cond. 2400/4160 V. 750° T.T.
1—3500 KW 2300 V Cond.
1—2500 KW 600 V Cond.
1—2500 KW 2300 V Cond.
1—3000 KW 600 V Cond.
1—2000 KW 600 V Cond.
1—1500 KW 2300 V Cond.
2—1250 KW 2300 V Cond.
1—1000 KW 2300 V Non-C.
2—1000 KW 440 V Cond.
1— 750 KW 600 V Extr.
1— 600 KW 240 V Cond.
1— 500 KW 600 V Cond.
1— 500 KW 240 V Non C.
1— 400 KW 480 V Non-C.
1— 250 KW 2300 V Non-C.

TURBO-GENERATORS (Continued)

1— 250 KW 240 V Non-C.
1— 150 KW 2300 V Non-C.
1— 125 KW 600 V Extrac.
1— 100 KW 600 V Non-C.
1— 50 KW 220 V Non-C.

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1—New 465 HP—3550 RPM —900 PSI.

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1—500 KW 2300 V Unit.
1—400 KW 125 V Unit.
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1—312 KVA 450 V Unit.
1—219 KVA 450 V Unit.
1—168 KW 220 V Unit.
1—168 KW 550 V

BOILERS

2—30,000# 425#
1— 550 HP 200#
1— 500 HP 400#
1— 300 HP 200#
1— 220 HP 160#
1— 200 HP 175#
6— 200 HP Sterling 160#
2— 190 HP 160# NEW
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1—6000 CFM 50# Motor
2—5600 CFM 50# Motor
1—4500 CFM 100# Motor
1—1300 CFM 100# Motor
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1—5000 CFM 10# Rotary Type Motor

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500 KW G. E. Syn. 600 V. DC, 900 RPM, 440/2300/4000/6900 V. AC, 3 P., 60 C.

400 KW West. Syn. 600 V. DC, 720 RPM, 2300/4000 V. AC, 3 P., 60 C.

300 KW G. E. Syn. 250 V. DC, 1200 RPM, 440/2300/4600 V. AC, 3 P., 60 C.

300 KW Rdwy. Syn. 250 V. DC, 1200 RPM, 2300/4000 V. AC, 3 P., 60 C.

150 KW G. E. Syn. 250 V. DC, 1200 RPM, 2300/4000 V. AC, 3 P., 60 C.

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Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines, generators, new or used.

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50,000 lb. Integral Furnace 400 lb. B & W boiler superheater air heater pulverizer fans accessories
2500 KW 2400 volt GE Cond. turbine unit.
1500 KW 480 volt GE NonCond Turbine set.
283 KVA 240 volt Chuse Uniflow engine set.
200 KVA 480 volt Ridgway 4 valve engine set.
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50 KW G. E. M. G. Set 220/440 AC 250 DC.

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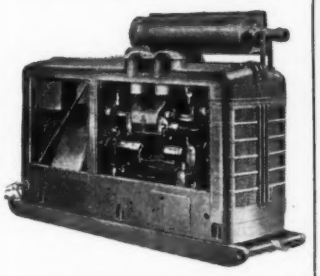
60 KW GMC DIESEL SETS

for

FOR IMMEDIATE DELIVERY



These fully-portable, self-contained units are offered at considerably less than manufacturer's list prices.

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TURBO-GENERATORS

1—6000 KVA Westinghouse 2400 V surf. cond.
1—3750 KVA G.E. 480 V. cond.
1—2500 KVA Allis-Chalmers 2300 V cond.
1—1250 KVA G.E. 480 V mixed pressure

ENGINE GENERATORS

2—575 KVA Skinner Unaflow—direct connected to Westinghouse 240/480 V gen.
1—575 KVA Allis-Chalmers full releasing Corliss 480 V
1—375 KVA Ames vertical 220/440 V
1—275 KVA Ridgeway N.R.C. 2300 V
1—187 KVA Ames vertical
1—158 KVA Ames vertical 240 V

DIESEL ENGINES

1—250 KVA G.M. 220/440 V 3 phase 60 cycle "twin" 6-71 diesel engine generating unit. New—not War Surplus.
1— 75 KVA Buda 240 V 3 phase 60 cycle generating unit. New—not War Surplus
Also General Motors, Fulton, Fairbanks and Nordberg engines from 15 to 1000 KW.

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Large stock of Transformers, Motors, M.G. Sets, and Generators

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VARIABLE VOLTAGE DRIVES
40 HP, Reliance, Variable Voltage Drive, each Consisting of:
1—40 KW 250 Volt, Induction M-G Set, with two auxiliary 5 KW generators and exciter.
1—40 HP 400/1500 RPM, Frame 385T, 230 Volt, DC Motor.
With full magnetic control providing jog forward, jog reverse, run, fast, slow, and stop, and motor operated field rheostat.

SLIP RING MOTORS—3 Ph., 60 Cy.

Qn.	H.P.	Speed	Volts	Make	Type
6	7½	810	550	G.E.	MTC-5201
1	7½	575	220	G.E.	MT-522
2	10	1140	440	West.	HF-7A
2	10	570	220	G.E.	HI-11
2	11½	810	550	G.E.	ITC-5008
2	15	1160	440	West.	CW-464C
2	15	570	220	West.	CW-646
1	18	680	440	West.	NW-316
1	20	860	440	West.	CW-638
1	25	1130	550	G.E.	MT-323
2	25	850	220	Wagner	BR
2	25	720	440	Wagner	22VBR
1	30	1130	440	G.E.	MT-326
1	30	865	440	West.	CW-646
1	30	850	440	G.E.	MT-332
1	30	575	440	G.E.	MT-336
2	35	600	440	F-M	HV-H16A
2	40	865	2200	Al.-Ch.	ARY-223C
1	40	560	440	G.E.	MT-346
1	50	1150	440	G.E.	M-536
1	50	869	440	West.	HF-12A
1	50	570	440	G.E.	MT-552
5	521	450	220	G.E.	IQC-5013***
1	60	685	440	West.	CW-758
1	60	570	550	G.E.	MTC-5546
1	60	45	550	West.	CW
1	80‡	575	440	G.E.	MTC-5352
2	125	430	440	G.E.	IL-16
2	150	1750	440	G.E.	MTP-549
1	175	865	550	West.	CW-1002
1	200	1760	2300	G.E.	IM-E13B
2	200	600	550	G.E.	IM-E
1	200	495	2200	G.E.	IM-17A
3	300	900	140	G.E.	IM-17
2	300	880	2200	G.E.	IM-17A
2	350	880	2200	G.E.	IM-17A
1	400	505	550	West.	CW
1	600	1770	440	G.E.	IM-E15C
1	650**	380	440	G.E.	MT-442Y
1	700	735	400011	West.	CW

All 220 volt motors can be reconnected for 440 volts.
‡ Intermittent rating. *** 2 phase.
** New. †† 50 Cycle. ‡‡ 25 Cycle.

230 Volt Constant Speed D.C. Motors

Qn.	H.P.	Speed	Make	Type
22	2	850	West.	SK-20
7	3**	1150	Al-Ch.	EB-71
10	3	850	Reliance	Y-33T
25	3½	850	West.	SK-30
1	7½	1150	G.E.	CDM-66
3	7½	850	G.E.	CD-75
10	10**	1750	Kimble	BA-324
5	10**	1150	Al.-Ch.	EB-80
2	10	850	West.	SK-83
10	13½**	600	West.	SK-93
3	15	1750	G.E.	CD-75
5	15	825	West.	SK-90
1	20	1750	L.A.	ONA-L851
1	20	1750/1310	West.	SK-83
2	20	1150	G.E.	RC-30
11	20	750	West.	SK-1101
17	25	825	West.	SK-120
2	30	1100	G.E.	RC-12
1	40	1700	West.	SK-103
1	40	750	G.E.	RC-34
1	50	750	West.	SK-160
1	50	650	G.E.	RC-14
1	60	1750/1310	West.	SK-143
1	150	700	Al.-Ch.	
2	200	1150	G.E.	RC-38
1	250	1150	C.W.	CMC-101A

230 VOLT ADJ. SPEED D.C. MOTORS

10	1½	500/200	G.E.	CD-65
1	2	225/900	Reliance	78T
1	5	450/1800	G.E.	CD-83
2	5	450/1800	G.E.	RF-9
6	5/7½	600/1800	G.E.	RA-30
1	10	400/1600	Reliance	T-92T
2	10/15	600/2400	Reliance	T-92T
1	12½	225/840	West.	SK-130
10	12½**	600	West.	SK-93
1	15	600/1200	West.	SK-100L
1	20	300/1500	G.E.	RF-11
1	20/25	400/1600	Reliance	T-230-T
1	20/25	300/1200	West.	SK-153
1	25	400/1600	G.E.	RF-13
1	25	500/1500	G.E.	RF-12
1	23/29	300/1200	G.E.	RF-13
1	30	400/1200	West.	SK-163
1	30/40**	400/1600	G.E.	CD-1236
1	35	450/1500	West.	SK-1145
1	40/50	400/1200	Reliance	T-461T
1	75	500/1500	Cr.-Wh.	CCM
1	75	375-750	Cr.-Wh.	CMC-125H
3	100	225/900	G.E.	MPC-A
5	100	400/1200	Al.-Ch.	
1	100	320/980	West.	SK-200
1	125	450/1000	West.	SK-190
1	175	230/500	West.	SK-220
2	375	350/500	G.E.	MPC

** New.

SQUIRREL CAGE MOTORS—3 Ph., 60 Cy.

Totally Enclosed Fan Cooled, Ball Bearing

Qn.	H.P.	RPM	Volts	Make	Type & Frame
2	¼	1750	220	R&M (TE)	L-184
1	¼	1725	440	G.E.	K-63
4	1	1140	220	Howell	A-204
4	1.5	1150	220	L.A. (TE)	FB-225
5	1.5	1140	440	West.	CS-225
1	2	1735	220	G.E.	K-224
2	3	1160	440	L.A.	JS-254
1	5	3480	220	G.E.	K-225
2	5	1750	440	L.A.	JA-254
10	5	1730	440	G.E.	K-254
2	5	1165	440	L.A.	JA-284
5	7.5	1740	440	G.E.	K-284
1	10	3480	440	West.	CS-324
1	10	1140	440	Wagner	CP2-326
1	10**	860	220	West.	CS-365-EXPF
1	15	1745	440	West.	CS-326
1	15	1175	440	L.A.	JA-365
1	20	1750	220	G.E.	K-364
1	25	1760	220	G.E.	K-365
1	25	1200	550	G.E.	K-405
1	25	1170	220	L.A.	JX-405
1	25	705	440	West.	CS-W504

Splashproof, Ball Bearing

1	2	1735	440	G.E.	K-224
1	3	1160	440	L.A.	FS-254
23	5	1750	440	L.A.	FS-284
1	5	1735	220	G.E.	K-254
1	5	1160	440	L.A.	FX-284
1	10	3480	440	G.E.	K-284
1	15	1175	440	L.A.	JA-365
4	15	1150	440	L.A.	FX-365
2	40	1175	220	G.E.	K-445
3	50	1760	440	L.A.	FX-445A
5	50	1160	220	G.E.	K-504
1	125	1770	440	L.A.	FX-1078Y
1	150	1775	440	L.A.	FX-1188
3	150	880	440	L.A.	FX-1368
1	150	700	440	G.E.	KF-6336
1	200	885	440	L.A.	FS-1378

Open Type Motors

Qn.	H.P.	Speed	Volts	Make	Type
5	2	170	440	G.E.	KT-926
4	2	1160	440	West.	CS-926C
1	2	690	440	G.E.	KT-944
10	5	1740	440	West.	CS-232C
1	7½	3475	440	West.	CS
1	7½	1750	440	West.	CS-250C
3	7½	1165	440	G.E.	KT-952
2	7½	870	440	West.	CS-370C
5	10**	1760	440	L.A.	AGA-324
5	10**	1750	440	West.	CSP-324
3	10	1160	440	West.	CS-370C
1	10	885	440	G.E.	KT-902
1	15	3485	220	Reliance	AA-B3247
5	15**	1735	440	Century	8C326
1	15	1200	220	G.E.	KT-362
1	15	900	220	G.E.	FTR-512
1	20**	3475	220	West.	CS-326
1	20**	1750	440	Wagner	RPI-384
1	20	1750	220	West.	CS-W364
1	20	1200	220	G.E.	KF-512
2	20	1160	440	West.	CS-464C
2	20	900	220	G.E.	FTR-522
1	25	1800	220	G.E.	FT-512
5	25**	1740	440	Century	8C-364
1	25	1160	440	West.	CS-567C
1	25	900	220	Howell	8CRB-356***
2	25**	875	440	Master	FB-405
2	25	575	440	G.E.	KT-542
3	30	3550	550	G.E.	K-3648
1	30	1160	440	West.	CS-444
1	30	870	220	West.	CS-646
1	40**	3545	220	G.E.	KF-4048
2	40	1750	440	West.	CS-583C
2	40	2300	440	G.E.	FT-536
4	50**	1750	440	Wagner	RPB-405
1	50	850	220	West.	CCL
1	60**	1750	440	Ideal	AH-444
2	60	900	440	G.E.	KT-346
1	75	1160	440	West.	CS-662C
1	75	870	220	West.	CS-766A
2	75	860	220	G.E.	KT-852
1	100	690	220	West.	C
1	100	580	2200	G.E.	IK-15A
2	100	500	2200	West.	CS-930
1	100	495	2200	Al.-Ch.	AN
2	125	435	440	Al.-Ch.	AR
2	125	400	2300	G.E.	I-17-FR
1	200	580	550‡‡	G.E.	KT-5698
1	500	1200	440	G.E.	KTP-567
1	700	1800	2300/4000	West.	CS-4-39D-12

All 220 volt motors can be reconnected for 440 volts.
** New. *** 2 Phase.
‡‡ Reconnectable for 440 volts.

CRANE, MILL TYPE, 230 V. D.C. MOTORS

Qn.	H.P.	Speed	Make	Type
2 (115 v.)	¾	700	G.E.	CO-1803
2	¾	760	West.	MCB-206
2	9.5	750	G.E.	MDS-404AE
1 (new)	10	650	G.E.	MD-403-BF
1	25	600	G.E.	MDS-408AE2
3	25	590	Diehl	TE
2	27½	535	West.	K-7
2	35	750	G.E.	CO-1828
3 (new)	35	600	West.	CK-9
1	50	750	G.E.	CO-1829A
1 (new)	50	600	West.	CK-9
4	50	525	G.E.	CO-1830
1	50	470	G.E.	CO-3007
2 (new)	60	550	G.E.	COM-1831 AE

Above Items Represent a Partial Listing Only. Your Inquiries Will Receive Our Prompt Attention. All Equipment is Located In Our Cleveland Warehouse. We Have Controls for Most Items Listed

ELECTRIC GENERATOR & MOTOR CO.
4521 HAMILTON AVE. CLEVELAND 14, OHIO

MOTORS • GENERATORS • TRANSFORMERS

MOTORS
3 PHASE—25 CYCLE—220/440 VOLTS

H.P.	Make	Type	Frame	RPM
50	Fairbanks Morse	H16R	Ball Bearing	750
75	Fairbanks Morse	H16C	B.B. Slipring	750
75	Gen. Elect.	IK	2200 volt	750
75	Gen. Elect.	IR		1500
100	Allis Chalmers			1450
150	Gen. Elect.	IK-17		365
150	Gen. Elect.	IK-16		480
150	Gen. Elect.	IM-16	Slip Ring	490
150	Allis Chalmers			1450
150	Gen. Elect.	KT	557	1455
400	Gen. Elect.	IM 17A	Slip Ring	730
500	Gen. Elect.	IK		485
600	Gen. Elect.	MT	Slip Ring	490
600	Westinghouse	CS		490

MOTOR GENERATOR SETS

2—350 KW General Electric Sets 250 Volts D.C. driven by 500 HP, 3 Phase 25 Cycle motors
—Will rewind for 60 Cycle operation.

3000 CYCLE MOTOR GENERATOR SET

GENERATOR—1.5 KVA General Electric A.C. Generator, type A.F.C. form AL, single phase, 800 volts, 3000 cycle, 1800 RPM, serial #3513638.

GENERATOR EXCITER—1 KW, General Electric Generator, type KF, form KB, 125 volts, D.C., 1800 RPM, 8 amps., serial #1758709.

MOTOR—200 HP, General Electric synchronous motor, type TS, form CL, .8 P.F., 3 phase, 60 cycle, 440 volts, 1800 RPM, serial #3513638.

MOTOR EXCITER—8 KW, General Electric Generator, type KF, form KB, 125 volts, DC, 1800 RPM, 24 amps., serial #1758730.

Motor and Generator are direct connected, 4 bearing. Mounted on factory fabricated base, with direct connected exciters.

3000 Cycle Control is mounted in cubicle also containing 300 HP General Electric synchronous motor starting control.

FREQUENCY CHANGERS

All Sizes in Stock, 60 cycle to 90 cycle, 100 cycle, 120 cycle, 180 and any other high cycle if desired.

HORIZONTAL & DUPLEX
Compressor & Vacuum Pumps after Coolers, Filters

25 CYCLE MOTORS

1—1370 HP, Gen. Elect. Synchronous Motor Type A.T.I. 3/25/2200 Volts 150 RPM.

1—1900 HP, Gen. Elect. Synchronous Motor Type A.T.I. 3/25/2200 Volts 150 RPM.

NEW TRANSFORMERS

3—25 KVA Niagara O.I.S.C. 2400/120/240 1 Phase 60 cycle with taps
3—37½ KVA Niagara O.I.S.C. 2400/120/240 1 Phase 60 cycle with taps.
6—50 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.
3—75 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.
3—100 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.
3—100 KVA Niagara O.I.S.C. 2400/120/240 1 Phase 60 cycle with taps.
3—150 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.
3—200 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.
3—250 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.
3—333 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.

REBUILT TRANSFORMERS

Qu.	KVA	Make	Cycle	Voltage
3	50	Pitts.	25	11000/2300
2	50	Kuhlman	25	11500/2300/230/460
1	50	Kuhlman	25	11500/115/230
2	50	G. E.	60	2400/120/2400
1	100	G. E.	25	4600/230/460
3	400	Pitts.	25	12000/110

NEW MOTORS

300 New Gen. Elect. & Westinghouse Motors in stock from 1 to 100 H.P.

100 KVA TRANSFORMERS

3—100 KVA Gen. Elect. Transformers, Type H Form KF—2400/4160 volts primary 120/240 volts secondary. Price $450.00 each. Electrically O. K. F.O.B. truck, Minnesota.

MOTORS

1—75 HP, Fynn-Weischel Synn. 3/60/440/1200 RPM.
1—100 Gen. Elect. Slipring Type I Form M., 3/60/440/900 RPM.
1—100 HP, Gen. Elect. Type K (New Motor) 3/60/440/1800 RPM.
1—100 HP Westinghouse Slipring Type CW, 3/60/440/435 RPM.
1—100 HP, West. Slipring Type CW 3/60/440/1200 RPM.
1—100 HP, Gen. Elect. Slipring 3/60/440/1200 RPM
1—200 Gen. Elect. Type KT, 572 3/60/440/600 RPM
1—200 HP, Gen. Elect. Slipring Type I Form M, 3/25/440/500 RPM.
1—500 HP, Allis Ch. Slipring 3/60/2200/514 RPM.
1—500 HP, Gen. Elect. Type I Form K, 3/25/440/485 RPM.
1—600 HP, West. Motor Type CS, 3/25/550/490 RPM.
1—600 HP, Gen. Elect. Slipring Type MT, 3/25/550/490 RPM.

VARIABLE SPEED MOTORS

2—300/150 HP, General Electric Motors Type BTA.—3 Phase 60 cycle 440 volts 580/280 RPM with controls.

3 PHASE 550 VOLTS 25 CYCLE MOTORS

Write for our stock list of approximately 500—3/25/550 Voltmotors

ERIE ELECTRIC CO., INC.

124 CHURCH ST. BUFFALO, N. Y.
CL. 4758

TURBO GENERATORS

TURBINE OF THE MONTH

1—4000 K.W. General Electric AUTOMATIC EXTRACTION 250 lbs. I.S.P., 150° F.S.H., 3" abs., 15 lbs. G. extraction 3600 RPM, Surface Condenser, Generator 3 phase, 60 cycle, 2400 volts, Turbine Serial No. 37,000 Series.

1—2000 KW G.E. 6600v, 3 ph., 60 cy. with 175 lb. cond. turbine and dir. conn. exciter.

1—1000 KW Westg. 400#, 700°F, condensing 3 ph, 60 cy. 2400 V. Surface condenser.

1—450 KW Whse 250 lbs. I.S.P. Surface Condensers—Auxiliaries—3 phase, 60 Cycle, 400 Volts. Direct connected Exciter Equipment built 1944.

1—750 K.W. G.E. 250/275 lbs. I.S.P. condensing Type FN3, Serial No 61707, 3/60/440 volts.

1—300 KW G.E. 150/175 lbs. I.S.P., 5/15 lbs. G.B.P. non-cond., 3 ph., 60 cy., 480 v. dir. conn. exciter

1—1000 KW G.E. 2300/4150v, 3 ph., 60 cy. with 135/150 lb. condensing turbine.

1—500 KW G.E. 480v, 3 ph., 60 cy. dir. conn. exciter with 80/100 lbs. I.S.P. 10/15 lbs. B.P., non-condensing turbine. Factory Rebuilt Unit.

1—500 KW G.E. 2400 v, 3 ph., 60 cy. dir. conn. exciter, 175 lbs. I.S.P. 10/15 lbs. B.P. non-cond.

BELYEA COMPANY INC.

43 HOWELL ST. JERSEY CITY 6, N. J.
Phone—Journal Square 2-3334
ALSO N. Y. CITY LINE—RECTOR 2-7150

BOILERS

10 to 1000 H.P.
NEW-USED
RECONDITIONED
Steam, Gas and Electric Power Equipment

J. PARKER THOMPSON CO., INC.
507 FIFTH AVE., NEW YORK CITY
MURRAY HILL 7-6547.8-9

FOR SALE
GAS ENGINE GENERATORS

3—375 KVA 60 cy 3 ph 440 volts Elliott Alternators Direct-connected to Ingersoll-Rand 400 RPM Gas engines—complete with exciters & switchboards. Can be rewound for 2300 volts. Running and in operation at this time.

INDEPENDENT ELECTRIC MCHY. CO.
300 SOUTHWEST BLVD.
KANSAS CITY 8, MISSOURI

For Immediate Delivery

TRANSFORMERS: 3—2000 KVA, 1 ph. 60 cy. 66,000 v. primary, A-1 condition.
BOILER: 30,000# steam per Hr. 425#, 500°
TURBO & ENGINE GENERATORS.
DIESEL SETS.

STEPHEN A. DOUGLASS CO.
630 Fort Washington Ave., New York 33, N. Y.

NEW AND USED
SHEET PILING—STRUCTURAL STEEL
ACORN IRON AND SUPPLY CO.
915 No. Delaware Ave., Philadelphia 23, Pa.
Phone: WAlnut 2-7070

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asme—BOILERS—Nat'l Board

2—404 HP sectional steel header WT single set oil fired boilers 170#
2—200 HP (3) drum low head bent tube boilers stoker fired (NEW never erected) 160#
1—600 HP vertical bent tube having extra large extension furnace 10' deep, 25' high, complete plant

H. P. BREARLEY
34-25 91st St., Jackson Heights, N. Y.

TRANSFORMERS FOR SALE

3— 500 KVA A-Ch 33000-2300
3— 500 KVA G-E 2400-240/480
1— 400 KVA G-E 13200-120/240
6— 333 KVA G-E 33000-2300/4000Y
3— 333 KVA G-E 13800 120/240
1— 333 KVA G-E 13800-230/460
1— 250 KVA G-E 6900/11950Y-230/460
2— 250 KVA W-H 2400-120/240
4— 150 KVA G-E 22000-2300/4000Y
3— 150 KVA Wag 2300-230/460
3— 150 KVA G-E 2300/4000Y-230/115
4— 100 KVA G-E 33000-2300
3— 100 KVA Pitts 22000-2300
3— 100 KVA G-E 11000-2300/4000Y
1— 100 KVA G-E 13200-2400
3— 50 KVA G-E 33000-2400/4160Y
3— 50 KVA Pitts 26400-2300/4000Y
6—37½ KVA W-H 13200-120/240
80— 5 KVA G-E 2300-115/230
10— 1½ KVA Wag 7200-120/240 "REA"

TRANSFORMERS WANTED

Reliable rewind and repair service on all makes of transformers.

THE ELECTRIC SERVICE CO.
CINCINNATI 27, OHIO
Estab. 1912

CENTRIFUGAL PUMPS

Split Case Double Suction
Cast Iron Bronze Fitted

With or without motors

2—14"x12" Dayton Dowd Type CSLH Capacity 6000 GPM 110' Hd 1750 RPM, serial No. 33199 200 HP

1—12"x10" Dayton Dowd Type CSLH 3000 GPM 113' HD 1750 RPM serial No. 31454

1—6"x5" Dayton Dowd 1000 GPM 231' HD 100 HP motor

1—6"x5" Allis-Chalmers Type S-1000 GPM 220' HD 100 HP 1750 RPM All Bronze

1—5"x4" Gould 500 GPM 1320' Hd 4 Stage Fig. 3360 250 HP 3450 RPM

1—2½"x2" Dayton Dowd 4 stage 80 GPM 1050' HD 50 HP 3450 RPM

We carry in stock a complete line of new and rebuilt pumps from ½" to 16". All pumps sold on a rebuilt and guaranteed basis as to condition and performance.

WE SOLICIT YOUR INQUIRIES

C & S MACHINERY COMPANY
715 Howard St., St. Louis 6, Mo.

FOR SALE

GEAR TRANSMISSION

300 HP Sturtevant
2515 to 900 RPM Design #3

ELECTRIC APPARATUS REPAIR CO.
1400 No. 6th St., Phila. 22, Pa.

NEW TRANSFORMERS

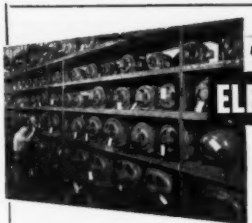
2—300 KVA Moloney 3 Ph. 50 Cy. 22,000-11,000 x 3,300, OISC

3—150 KVA Moloney 3 Ph. 50 Cy. 22,000-11,000 x 3,300, OISC
OK for 60 cycles 13,800 x 4140

4—25 KVA 230-400 x 110

$4.00 per KVA

SAMUEL M. DAVIS
510 LaSalle St., St. Louis 4, Mo.



A COMPLETE STOCK OF . . . ELECTRICAL POWER EQUIPMENT

HERE'S A PARTIAL LISTING OF OUR TREMENDOUS STOCK AVAILABLE AT

MONEY SAVING PRICES

IN QUALITY GUARANTEED REBUILTS

CHICAGO ELECTRIC

Carries a complete stock of rebuilt equipment of the following types:

- Squirrel Cage Motors
- Synchronous Motors
- Slipring Motors
- AC and DC Generators
- DIESEL and Steam Generators
- Transformers
- Switchboards
- Controls
- Hoists and Cranes
- Compressors

REBUILDING SERVICE

Prompt guaranteed engineering work on your electrical power equipment by our staff of experienced engineers. Write today.

TRANSFORMERS

KVA	Make	Type	Pri. V.	Sec. V.
2100	G.E.	HT	13200	2300
2000	G.E.	H	25000	2300
1800	Westg.		13800	440
1667	Wagner		2300	575
1500	Gregory	BIT	4160	480
1250	Moloney	C	4160/7200Y	240/480
1200	G.E.	WCT	12000	110/87
750	Gregory	BIT	4160	480
500	Gregory	BIT	4160	480
333	G.E.	H	44000	2300/600
250	G.E.	H	13200/26400	575
200	Ferranti		2200	440
200	G.E.		7200/12575	2300/440
200	G.E.	H	2400	240/480
200	Chgo. Neco.		2400	240/480
150	Moloney	HE	4600/2300	230/460
150	Chgo. Neco		13200	2300
150	G.E.	HL	2400/4160	240/480
100	Pittsburgh		66000	2300/4000Y
100	G.E.		7260/12575	2300/4000
100	Chgo. Neco		2400	120/240
50	Westg.	SK	2400/4160	240/480

MOTOR GENERATOR SETS

K.W.	Make	Volts AC	Volts DC
1500	Westg.	3/25/6600	250
1563	G.E.	3/60/2300	3/60/2300
1200	G.E.	3/60/5000	125/250
1200	Al. Ch.	3/60/4000	600
1000	Westg.	3/25/2300	250
1000	G.E.	3/60/2300	600
1000	G.E.	3/60/440	250
500	G.E.	3/25/2300	230
500	Cr. Wh.	3/60/2300	575
500	G.E.	3/60/440	250

LOW VOLTAGE M.G. SETS

K.W.	Make	Volts D.C.	Volts AC
5000	Ideal	9/18	3/60/220/440
1500	Chandy	40	3/60/220/440
1500	G.E.	60	3/60/2300/440
1000	Chandy	40	3/60/220/440
1000	G.E.	40	3/60/220/440

A.C. GENERATORS

KVA	Make	Type	Volts	Speed
1500	Westg.		2300	900
1000	Westg.		2300	900
1000	E.M.		2400/480	600
750	E.M.		2300	213
750	G.E.	TS	2300	750
560	Al. Ch.	3-B	440	360
500	Westg.		440	600
500	Westg.		2300	720
500	Westg.		440	1200
500	Westg.	25 cy.	2300	750

SQUIRREL CAGE MOTORS

H.P.	Make	Type	Volts	Speed
700	G.E.	K	2200	1800
500	G.E.	K	440	3600
500	G.E.	KTP	440	1800
400	Al. Ch.	Spl. pf.	2300	900
400	Westg.	C.S.	2200	1800
350	Westg.	C.S.	2200	900
300	G.E.	I.K.	440	900
250	G.E.	I.K.	2200	900
250	Westg.	C.S.	2200	1800
200	G.E.	K	2300	720
200	G.E.	K.F.	2200	705
200	Westg.	C.S.	440	720
150	G.E.	K.T.	2300	600
150	Cont.	TEFC	440	900
125	Westg.	C.S.	440	3600
125	G.E.	TEFC	440	1200
100	Al. Ch.	A.R.	440	514
100	Al. Ch.	A.R.	440	900
100	U.S.	Vert.	440	1200
100	Burke	E.M.	440	1200
75	Triumph	T.E.	2200	514
75	G.E.	F.T.	440	720
75	Westg.	Vert.	2200/440	900
75	G.E.	K.	220/440	1200
75	Al. Ch.	A.N.	440	1200
60	Al. Ch.	A.R.	440	514
60	G.E.	K.	440	1800
60	G.E.	TEFC	440	1800
50	Westg.	C.S.	440	900
50	G.E.	KT-346	440	900

SYNCHRONOUS MOTORS

H.P.	Make	Type	Volts	Speed
1500	G.E.	ATI	4150	514
1000	Westg.		2300	900
710	G.E.	ATI	6600	720
700	G.E.	ATI	2300	720
600	G.E.	TRC	2300	450
450	E.M.		440	240
400	Westg.		2300	900
400	Westg.		2300	200
350	G.E.		2300	200
350	G.E.	TRB	2300	450
250	G.E.	ATI	440	600
250	Al. Ch.		2300/4000	720
200	Al. Ch.		2300/440	360
150	Westg.		2300	514
145	G.E.	ATI	440	900
100	G.E.	ATB	2300	900
75	G.E.	ATI	220	900
60	G.E.	TS	220	1200
15	Century		440	1200

SLIPRING MOTORS

H.P.	Make	Type	Volts	Speed
3000	G.E.	I.M.	2200	120
1500	Westg.	H.F.	2300	233
1500	G.E.	M.T.	6600	253
1000	Al. Ch.	ANY	2300	240
800	Westg.	C.W.	6600/440	507
750	Westg.	C.W.	2300	900
750	G.E.	M.T.-16	2200	450
600	G.E.	I.M.	2300	600
600	G.E.	I.M.	440	352
500	Ideal	A.V.	2200/4000	1800
500	Al. Ch.	ANY	2300	514
400	G.M.	I.M.	2300	900
400	Al. Ch.	ANY	4000	1180
400	Al. Ch.	ANY	4000	514
350	G.E.	I.P.	2300	720
350	Westg.	C.W.	2300	450

CHICAGO Electric Co.

1320 W. CERMAK ROAD CHICAGO 8, ILL.
PHONE: CAnal 6-2900

MAY OFFERINGS

1—B & W—Water Tube Boiler 200# P.S.I. A.S.M.E.—Natl. Board—400 H.P.

2—Heine-Water Tube Boilers—225# P.S.I. Cross Drum—Steel Cased—3½" tubes—Retubed 1943

2—Union Iron Works—375 H.P.—Water Tube Boilers

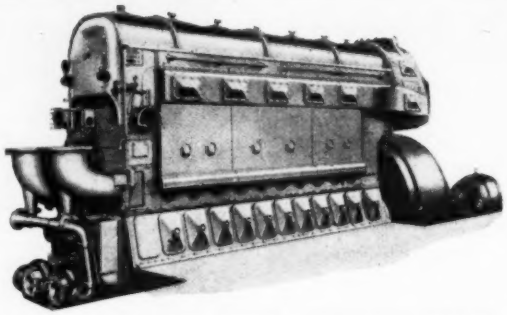
Also New Package Units—30—300 HP—15#—100#—125#—150#

HOWE BROTHERS

342 MADISON AVENUE NEW YORK 17, N. Y.
Tel. Nos. MU. 2-8562—8563—8564

DIESEL ENGINE GENERATORS

Immediate Delivery



2—Fairbanks Morse O. P. MOD 38D8⅛—1600 HP direct connected to Fairbanks Morse 1420 KVA—1136 KW—3 Ph—60 CY—2300/4000 Volt—720 RPM Alternaters with 10 KW direct connected Exciters.

3—Fairbanks Morse O. P. MOD 38D8⅛ 1600 HP direct connected to Crocker Wheeler 1250 KVA—1000 KW—3 PH—60 CY—2300/4000 Volt—720 RPM Alternaters with 10 KW direct connected Exciters.

5—General Motors MOD 3-268A—150 HP, direct connected to Westinghouse 100 KW—3 PH—60 CY—480 Volt—1200 RPM Generators with direct connected Exciters.

2—ALCO (McIntosh & Seymour) 900 HP type 6—12½ x 13—T, direct connected to GE-620 KW, 240 volt D. C. 700 RPM generators with direct connected exciters.

2—General Motors MOD 3-268A—150 HP direct connected to Delco 100 KW—120/240 Volt, 1200 RPM 3 wire DC Generators.

WALTER H. WILMS & COMPANY
2526 GUARDIAN BUILDING DETROIT 26, MICHIGAN
Phone: Woodward 1-1856 and 1-1857

FOR SALE

4000 KW TURBINE GENERATING PLANT

Consisting of

1—2000 KW and 2—1000 KW General Electric, 3 phase, 60 cycle, 480 Volts, 3600 R.P.M. Condensing Turbo Generator Units. Complete with all Auxiliaries. General Electric inspection reports are available.

A. G. SCHOONMAKER CO., INC.
52 CHURCH ST. Digby 9-4350 NEW YORK 7, N. Y.

FOR SALE

2—1800 HP Fairbanks-Morse, Model 38D 8⅛, 8⅛"x10", 800 RPM, 10 cylinder, air start, solid injection, complete with auxiliaries. Excellent Condition.

Unused 450 HP Enterprise Diesel engine, Model DSG-6, 6 cyl., 4 cycle, 450 RPM, air start, solid injection.

3—Allis Chalmers 1000 gal. per min. All Bronze 6x5 Centrifugal pumps, driven by Hercules Diesel engines, 6 cylinder, Model DWXDS, 1800 RPM. Rebuilt.

OTHER SIZES IN STOCK

ALJOHN DIESEL CO., INC.
904 Pacific St., Brooklyn 16, N. Y.
STerling 3-6515

TRANSFORMERS

FOR SALE

2—150 KVA. 60 CY. 1 PH. 2400-240/480 SCOTT TAPS.
6—100 KVA. 60 CY. 1 PH. 2400-240/120.
6— 75 KVA. 60 CY. 1 PH. 2400-240/120.
9— 50 KVA. 60 CY. 1 PH. 2400-240/120.
7—37½ KVA. 60 CY. 1 PH. 2400-240/120.
8— 15 KVA. 60 CY. 1 PH. 2400-480/240.

ALSO ALL TYPES OF AIR COOLED AND PHASE CHANGERS.

ATLANTIC TRANSFORMER CO.
5143 N. 2nd St. Philadelphia 20, Pa.

NEW MOTORS

IMMEDIATE SHIPMENT

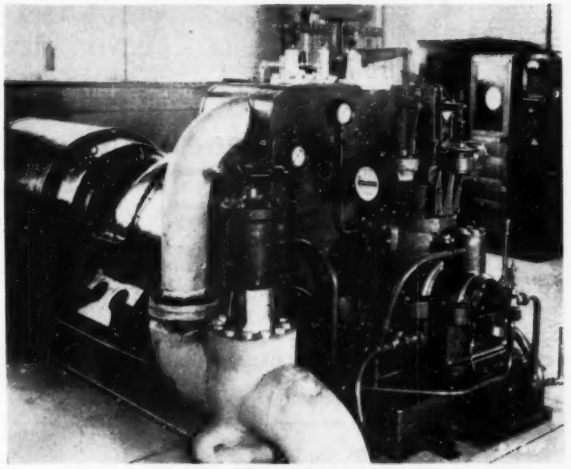
30% DISCOUNT

G.E., WEST., ALLIS CHALMERS, RELIANCE, CENTURY, ETC.

From 1 HP to 300 HP
1, 2, & 3 Phase
All Speeds All Voltages
Open, Drip Proof
Splash Proof, T.E.F.C., Exp. Pr.
Large stock of rebuilt transformers, motor generators, etc.

ELECTRIC EQUIPMENT COMPANY
Rochester, N. Y.—Phone Glenwood 6783

STRICTLY UTILITY, EFFICIENT WESTINGHOUSE CONDENSING STEAM TURBO-GENERATOR UNIT



(Actual View of Installation)

AVAILABLE IMMEDIATE SHIPMENT

Westinghouse, 3600 RPM condensing steam turbo generator unit consisting of:

TURBINE

1500 KW, 250 P.S.I., 150° S. H. 28 inch vacuum direct connected to:

ALTERNATING CURRENT GENERATOR

1875 KVA, 1500 KW, 80% P.F. 3 phase 60 cycle, 2400 volt 451 Amp. complete and equipped with:

ACCESSORIES

2700 square foot Westinghouse surface condenser, condensing auxiliaries, piping, valves, duplicate exciter sets, switchboard panels and instruments.

EXCELLENT CONDITION

Utilities Electrical Machinery Corporation

600 NATIONAL CITY BANK BUILDING • Long Distance Phone 422 • CLEVELAND 14, OHIO

MOTORS and GENERATORS

1—150 HP G-E CR1034-K22 Compensator, 3/60/220

1—300 KW G-E Rotary Converter 3/60/440 (can supply transformers for 2300) 250/275 v d-c 1200 RPM complete

1—900 KW 440 v d-c, 700 RPM, Al-Ch single B B gen.

1—540 KW Whse Turbo-Gen 240 v d-c, 200 lbs. non-cond., new 1944

2—90 HP 575 RPM 230 v d-c Whse SK Marine motors w/starters

1—400 HP 900 RPM 3/60/440 G-E S1 Rg 1-M

1—350 HP 720 RPM 3/60/440 Whse S1 Rg CW

2—200 HP 900 RPM 3/60/550 (or 440) Whse S1 Rg CW

2—150 HP 514 RPM 3/60/550 (or 440) West Elec. S1 Rg

6—333 KVA 13,200-460/230 Wagner 12 ROC trans 1 ph., 60 cy. OISC

1—667 KVA 4160-2400 G-E trans. 1 ph., 60 cy. PYRANOL 8-7.28% taps

C & S MACHINERY COMPANY
715 Howard St., St. Louis 6, Mo.

FOR SALE

150 HP ASME 125# Self-contained Boiler
242 KVA 2300/440 V. Gen. D/C Uniflow Eng.
200 HP 220/440 V. 600 RPM Sq. Cage Motor
3000/7000 HP Permutit Water Softener
1000, 500 & 300 HP Water Tube Boilers
880 & 400 KW Diesel Engine—Gen. Sets

H. & P. MACHINERY CO.
6719 Etzel Ave. St. Louis 14, Mo.

FOR SALE

One 350 HP Model VD-MB 8 cylinder 4 cycle Superior full diesel engine: Fairbanks-Morse diesel units 60 HP up to 600 HP with clutches or generators: Gas engines, high or low speed, with or without generators: Steam engine generating units 75 KW up to 450 KW. Write me your needs.

A. C. ASKEW, Box 5073
Whittier Station, Tulsa 8, Oklahoma. Phone 8-8120

Quality SINCE 1906 — Wente — *Motors*

WIDE SELECTION UNUSUAL VALUES

THEIR ELECTRICAL CONSTRUCTION HAS BEEN REBUILT . . . BY EXPERTS

SQUIRREL CAGE
3 ph.—60 cy.—220 or 440 V.
(Other voltage as noted)

Qu.	HP	Make	Type	Speed
1	50	Al. Ch.	I (2200 V.)	900
2	50	Al. Ch.		900
1	60	G.E.	KT	1800
4	60	G.E.	KT (2200 V.)	1200
1	60	Reliance	AA	900
1	100	G.E.	I-16	450
1	100	G.E.	KT (2200 V.)	900
4	100	G.E.	K (TEFCBB)	1200
1	110	G.E.	KTP	1800
1	120	G.E.	FT	3600
2	125	Cr. Wh.	126Q	450
8	125	Al. Ch.	AR	450
2	150	Al. Ch.		1750
1	250	G.E.	I-17	900
1	250	G.E.	KF (Vert.)	3600

SLIP RING—SYNCHRONOUS
3 ph.—60 cy.—220 or 440 V.
(Other voltage as noted)

1	50	Al. Ch.		520
1	50	Al. Ch.		720
1	50	Ideal	AV	600
1	50	G.E.	I	700
1	60	Ideal	AVX	1200
1	75	West.	CW	400
1	75	G.E.	I	520
2	75	Fair. Morse	BV (2200 V.)	1800
1	100	G.E.	TRB	600
4	100	G.E.	I-16 (2200 V.)	450
	100	West.	CW (S. P.)	1800

Qu.	HP	Make	Type	Speed
1	100	KW G.E.	ATB (8 PF)	900
1	125	Fair. Morse	T (2400 V.LO PF)	900
1	150	G.E.	TR (8 PF)	1800
1	200	G.E.	TRC (8 PF)	400

D.C.—230 Volt
(Other voltage as noted)

1	50	West.	SK	850
1	50	G.E.	CD 1341	500/2000
3	50	Reliance	T	2700
1	50	West.	SK (115 V.)	500
1	60	West.	SK (115 V.)	500/1500
1	75	Diehl	K11	700
1	90	Cr. Wh.	CMC	225/550
1	100	West.	SK	850
1	100	Cr. Wh.	CM	600
1	130	Cr. Wh.	CMC (550 V.)	1200
1	150	West.	SK	850
1	180	Cr. Wh.	CMC	450

M-G SETS

1— 45 KW West./60 V DC—440 V AC 1200 RPM
4— 60 KW G.E. 60 V DC—440 V AC 1200 RPM
3— 75 KW El. Mach. 230 V DC—440 V AC 1200 RPM
2— 75 KW El. Prod. 220 V DC—440 V AC 1200 RPM
1—100 KW Ridge. 250/275 V DC—440 V AC 1200 RPM
1—105 KW Century 70 V DC—440 V AC 1200 RPM
1—150 KW G.E. 250/275 V DC—440 V AC 900 RPM

ALSO—*4000 motors other than listed from 1 HP to 800 HP*

Wente SINCE 1906 — *The Wente Electric Co.,*
Hamilton 203 NO. FOURTH ST. Phone 4-8128 *Ohio*

POWER EQUIPMENT

INSPECTION INVITED

IMMEDIATE DELIVERY

DIESEL ENGINES

General Motos 900 HP Model 12-567, 2 cy. 12 cyl. 744 RPM with Falk reversing and reduction gear, ratio 2½ to 1. Electric starting. Auxiliaries available.

DIESEL GENERATORS

100 KW DC 240/120 V., 417 Amps., 1200 RPM. Motor: Superior, 150 HP Model GDB-8, 8 cyl., Electric Starting. Auxiliaries Available.

TURBO-GENERATORS

132 KW. AC, GENERAL ELECTRIC, Generator: 450 & 220 V, 3 Phase, 60 cycle, 1200 RPM. 275 Amps. Exciter: 40 KW. DC. 120 V. 22.6 Amps. Reduction Gear: 10071 to 1200 RPM. Turbine: 172 KW. Condensers available.

60 KW. DC. WESTINGHOUSE, Generator: 120 V. 1800 RPM. 500 Amps. Reduction Gear: 7283 to 1800 RPM. Turbine: 60 KW. 89.4 H.P. Condenser available.

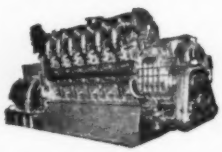
NUMEROUS OTHER ITEMS ARE AVAILABLE FOR INDUSTRIAL USE.

FOR COMPLETE INFORMATION
WRITE PHONE

NORTHERN METAL CO.

MILNOR & BLEIGH STS. —SHIPBREAKERS— PHILA. 35, PA.

PHONE: MAyfair 4-1400



DIESEL Generator Plants

1000 KW TO 100 KW

For Immediate Delivery

1000 KW, 2400 Volts, 3 Phase, 60 Cycle, 720 RPM, General Motors and Fairbanks-Morse.
750 KW, 2400 Volts, 3 Phase. 60 Cycle, 720 RPM, General Motors.
300 KW, 450 2400 Volts, 3 Phase, 60 Cycle, 1200 RPM, General Motors.
100 KW, AC or DC, 1200 RPM, General Motors.
900 HP, General Motors, Propulsion Unit Complete.
General Motors Quads, Twins, and Singles.
Fairbanks-Morse O. P. Model 38D8 1/8 Diesel.

HERCULES ELECTRIC MACHINERY and EQUIPMENT CO.

Tel. NEvada 6-2808 — 1412 So. Alameda Street
Cable Address HEMCOY — Compton, Calif.

TRANSFORMERS

3—150 KVA, 2400 volts primary to 230/460 volts secondary, 60 cycle, 1-phase, Moloney, new.
3—150 KVA, 13,800 volts primary to 130/260 volts secondary, 60 cycle, 1-phase, Wagner late model, steel case.
3—667 KVA, 13,800 volts primary to 230/460 volts secondary, 60 cycle, 1-phase, Wagner late model, steel case.
1—100 KVA, 33,000 volts primary to 2300/4160 volts secondary, 60 cycle, 1-phase, General Electric, type "H", Form K.D., steel case.
1—37½ KVA, 4000 volts primary to 115/230 volts secondary, 60 cycle, 1-phase, General Electric, type "H", Form K, steel case.
1—10 KVA, 6,600 volts primary to 110/220 volts secondary, 60 cycle, 3-phase, Moloney, Type "T", C.I. case.
1—100 KVA, 6900 volts primary to 115/230 volts secondary, 60 cycle, 1-phase, General Electric, Type "H", Form KR, steel case.

All in Stock for Prompt Shipment. Will Be Overhauled and Guaranteed.

INDEPENDENT ELECTRIC MACHINERY COMPANY

300 Southwest Boulevard — Kansas City, Missouri

FOR SALE

4—ROTARY CONVERTERS:

Synchronous Converters	Serial Numbers
General Electric	
Type HCC 6 1500 500	3940449
Form J	3940450
Cycle 25	3940451
Speed 500	4099467
Direct Current	
Amp. 2500 nominal	
Volts 600	

3750 amp. 2 hrs. 55° C. rise.

2—INGERSOLL-RAND CAMERON PUMP DIVISION CENTRIFUGAL HYDRAULIC PUMPS:

1—Size 5 CT-6 — Serial A412011
GPM 865 — Head ft. 1190
RPM 1450 — Hyd. Test 1500
Year Built October 1941.

1—Size 5 HST-5 — Serial 06443253
GPM 865 — Head ft. 1120
RPM 1450 — Hyd. Test 1500
Year Built June 1944.

1—G.E. INDUCTION MOTOR:

Model 23E949 — Phase 3
Type KT — Cycle 25
Volts 6600 — Speed, full load 1475
F.L. amp. 53 — 700 HP continuous 40° C. rise Serial 4228896
Year Built 1923

CLEVELAND IRON & METAL CO.

2432 West Third St. Cleveland 13, Ohio

BOILERS

3—300 h.p., BMW National Board 200 lbs. pressure straight tube.
1—250 h.p. Fitzgibbons self-contained National Board unused 125 lbs. pressure.

Immediate delivery location Philadelphia

M. J. HUNT SONS
1600 N. Delaware Ave., Phila. 25, Pa.

Memo to "P.E." (POWER ENGINEER)

STOP! LOOK! LISTEN!

One of the largest stocks of Electric Motors, Generators, Controls, Transformers, etc., in the East is ready for your inspection.

JUST A FEW OF THE MORE THAN 35,000 ITEMS

8—40 HP GE Type MTC5522 Slip Ring Motors
6—250 KW Westinghouse DC Generators 240/120 Volts, 1200 RPM
1—400 KW Motor Generator Synch. Driven 250/120 volts DC
10—1000 & 1500 Amps Multi-Arc Welding Generators AC Motor Driven
2—200 KVA AC Generators 600 rpm
1—219 KVA AC Generator 257 rpm
1—100 HP Electro Dynamic 1800 rpm, 230 volt, DC Motor
3—150 HP Crocker Wheeler 900 rpm, 230 Volt DC BB TEFC Motors
2—250 HP GE 3 Ph, 60 Cy., 440 Volt, 1800 rpm Motors
1—200 HP GE 3 Ph, 60 Cy., 2300 Volt, 257 rpm Synch. Motor
1—450 HP West. 3 Ph, 60 Cy., 440 Volt, 500 rpm Slip Ring Motor
25—Gasoline Driven Generators AC & DC from 3 KW to 100 KW

STOCK LIST AND QUOTATIONS ON REQUEST

Immediate Shipment from 3 Warehouses

ALL EQUIPMENT REBUILT TO N.I.S.A. STANDARDS

EMPIRE ELECTRIC CO., INC.
87-93 JAY STREET · BROOKLYN 1, N. Y.
TEL.- MAIN 4-6868

FOR SALE

COMPLETE 2500 KW STEAM POWER PLANT

consisting of two, 1250 KW 3-phase 60-cycle, 2300-volt, Allis-Chalmers turbo-generators with control panels, condenser, boilers, economizers, super-heaters, feed water regulators, pumps, piping, induced-draft fan, direct firing coal pulverizers with bin and stand-by fuel oil burning equipment. All equipment complete with motors and controls where required. In excellent condition and now available.

CONSOLIDATED CEMENT CORP.
111 W. Monroe St. Chicago 3, Ill.

FOR SALE

Complete — Modern — Like New

800 K. W. TURBO GENERATING PLANT

250# pressure—3/60/2300 volt
Consists of Turbines—boilers—stokers—pumps and all auxiliaries
Still in operation—Inspection Invited
Can be purchased at a fraction of new replacement cost

Phone — Wire or Write

CHICAGO ELECTRIC COMPANY
1320 CERMAK ROAD • CANAL 6-2900 • CHICAGO 8, ILL.

SURPLUS ELECTRICAL EQUIPMENT

2—2100 HP, GE Synchronous motors, 514 RPM, 4600/2300 V, 3 phase, 60 cycle, 80% P.F. Complete with rheostats and belted exciters. Full details on application.
2—2000 KVA Transformers—Single phase 60 cycle 69/34.5 KV to 4800/2400 V. Westinghouse O.I.S.C.
1—3500 KVA—3 phase, 60 cycle, 33/13.8 KV Westinghouse Transformer.
1—600 A., 3 P.S.T., 34.5 KV Outdoor O.C.B. Westinghouse CO-1-A.
1—3 pole, 600 A. 34.5 KV Outdoor Disconnect Switch.
Miscellaneous Distribution Transformers, Cable, Switches, Potheads and Electrical Instruments. Also Ross Carrier—hardly used. Arch measurements—91" high and 76" wide. 7 Ton capacity.

All the above are for immediate sale and are located at our Pulp Mill on Vancouver Island.

BLOEDEL, STEWART & WELCH, LTD.
904 Standard Building, Vancouver, B. C.

COMPLETE POWER PLANTS

STEAM — ELECTRIC — HYDRO — DIESEL

"Export Orders Carefully Executed"

BOILER UNITS

1—140,000# New Steam Generator 600#
1—140,000# MODERN Steam Generator 450#
2—90,000# MODERN Boilers 450#
2—40,000# MODERN Boilers 250#
2—30,000# MODERN Steam Generators 450#
2—1040 HP Heine Boilers—Super 200#
2— 825 HP B&W Co. Stirling—Super 200#
2— 600 HP B&W Co. Sectional—Super 200 to 350#
3— 310 HP B&W Co. Stirling 180#
Also smaller Boilers & Fire Tube Boilers

TURBO UNITS

1—7,500 KW Turbo-Generator—Cond.
3—5,000 KW Turbo-Generators—Cond.
1—4,000 KW same as above
2—2,500 KW same as above
3—2,000 KW same as above
2—1,500 KW same as above
2—1,250 KW same as above
2—1,000 KW same as above
1— 500 KW same—Also 750 KW & 300 KW Units
Non-Cond—500 - 500 - 750 - 1000 - 1500 - 2000 - 2700 KW.

COMPLETE STEAM PLANTS: One with 2-1500 KVA's, One of 2500 KVA & One of 7500 KVA.
Frequency Changers—Transformers! Send us your requirements—We may have it.
Send us your INQUIRIES *for* ALL POWER MACHINERY

CHARLES B. REARICK 30 CHURCH ST. NEW YORK 7, N. Y.

SLIP RING MOTORS
3-Ph., 60 Cy.

HP	Volts	Make	Speed
450	440/220	Whse.	514
300	2200/550	G.E.	900
250	2200/440	Whse.	500
200	440/220	Whse.	514
200	440/220	Whse.	900
200	2200/440	G.E.	1200
200	440	G.E.	450
150	440/220	Whse. (2)	1800
150	2200/440	G.E.	1200
150	440/220	G.E.	720
100 (2)	440/220	Whse.	900
100	2200/550	G.E.	1800
80	440/220	G.E. (MTC)	900
75	2200/550	G.E.	1800
75	440/220	Whse. 25 cy.	750

SYNCHRONOUS MOTORS
3-Ph., 60 Cy.

HP	Volts	Make	Type	RPM
400	440/220	G.E.	ATI	600
300	2200/440	G.E.	TS	600
300	440/220	G.E.	ATI	600
250	440/220	Whse.	HR	277
250	440/220	G.E.	ATI	600
240	440/220	Whse.	G	1800
200	4150/2300	Whse.	G	1800
120	440/220	G.E.	ATI	900
110	440/220	G.E.	TS	257
100	440/220	Whse.	G	1800
75	2200/440	Whse.	GE	600

GENERATOR SETS

1—62½ kva. 1200 rpm, 220 volt, Whse., geared to 7300 rpm. Whse., non-cond. steam turbine, 150 lbs. pr.
2—unused 25 kva, 120/208 v., 3 ph., 1200 rpm. generator dir. conn. to Waukesha 6 cyl. gas engine

AIR COMPRESSOR UNIT

1—13" and 8" by 10" Worthington FEATHER-VALVE, 285 rpm. 110 lbs. ga. motor-driven.

CIRCUIT BREAKERS

2—2000 amp., GG E, 3 pole, 600 v., air
2—1600 amp., ITE, 3 pole, 600 v., air
2—1200 ampere, Whse. 3 pole, 600 v., air

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
500	440/220	G.E.	IK	900
400	550	G.E.	IK	720
300	2200/550	Whse.	CS	1800
200	440	G.E.	IK	514
200	440/220	Whse.	CS	1200
200	440/220	G.E.	KT	1800
200	2200/440	G.E.	KF	720
200	2200/550	Cr. Wh.	SC	900
200	2200/440	G.E.	KT	1200
150	440/220	G.E.	KT	720
150	440/220	Howell	B. Brg.	1800
150 vert.	440/220	G.E.	KTP	1200
150	440/220	G. E.	IK	514
125	440/220(2)	G. E.	IK	514
125 vert.	440/220	G.E.	KTP	1200
100	550	Cr. Wh.	Q	900
100	2200/440	G.E.	K	1200
60	440/220 (new)	I. Allis	OGA	1800

A. C. GENERATORS

1—320 kva., 600 rpm., 440/220 v., G.E.
1—250 kva., 600 rpm., 2200/440 v., G.E.
1—225 kva., 600 rpm., 220/440 v., G.E.
1—150 kva., 1800 rpm., 2200/550 v., Whse.
1—112 kva., 900 rpm., 440/220 v., G.E.
1— 98 kva., 1800 rpm., 440/220 v., G.E.
2— 75 kva., 1800 rpm., 440/220 v., Whse.

D. C. MOTORS

HP	Volts	Make	Type	Speed
350	230 (2)	G. E.	CD	1150
200	230	Cr. Wh.	CMC	890
150	230 (new)	Cr. Wh.	TEFC	900
100	230	Cr. Wh.	CMC	625
100	230	G.E.	CD	1750
75	230 (new)	Whse.	SK	1150
75	230	Whse.	SK	850
75	230	Whse.	SK	1750

MOTOR GENERATOR SETS

1—165 kw, 1200 rpm, 240 v., G.E., conn. to 250 hp, 1200 rpm, 440/220 v., squirrel cage
1—150 kw, 900 rpm, 240 v., Cr. Wh., conn. to 225 hp, 900 rpm, 2200/550 v., squirrel cage.
1—125 kw, 1200 rpm, 250/120 v., G.E., conn. to 175 hp, 1200 rpm, 4000/2300/440 v., synchronous
1—75 kw, 125 v., 1200 rpm., G.E. conn. to 120 hp., 2200/440 v., syn. motor.
1—50 kw., 250 1200 rpm., G.E. conn. to 75 hp., 440/220 v., 60 cy., G.E. syn. motor.
1—50 kw., 250/1200 rpm., G.E. conn. to 75 hp., 440/220 v., 60 cy., syn. motor.

TRANSFORMERS
60 Cy.

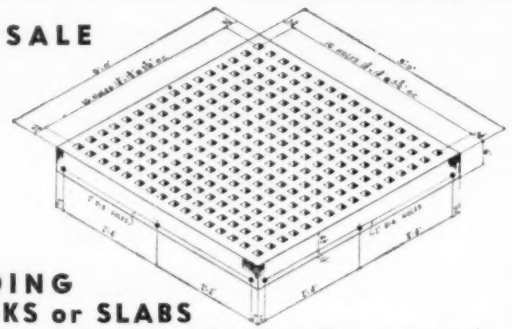
1—1000 kva., Al. Chal. 2400-120/240/208 volts, 3 ph
1— 400 kva., G.E. 2300-230/115 v.
3— 200 kva., Moloney, 2400-240/480 v.
2— 150 kva., G.E., 13800/6900-110/220 v.
1— 150 kva., Whse. SK, 13200-125/215 v., 3 ph
3— 150 kva., G. E., 2300—230/460 volts
3— 100 kva, G. E., 13800—230/115 v. NEW
6— 100 kva., G.E., 4600/2300-230/115. NEW
3— 100 kva., G.E., 450-115/230 v., dry, 1 ph., new
5— 75 kva., G.E., 2400-240/120 v.
3— 75 kva., G.E., H-KF, 2300-230/460 v.

STEPHEN HALL & CO.

HARRY J. RICE PRES.

458 SEVENTH ST. HOBOKEN, N. J.

FOR SALE



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All 220/440 Volt

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2	150	720	Elliott
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2	500	1200	Elliott

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1	2	45	225	Stlg.
2	2	125	254	U.S.
1	2	230	224	Stlg.
7	3	45	254	Whse.
4	3	350	225	Whse.
8	5	41	254	Whse.
4	7½	25	324	U.S.
1	10	20/60	324	Stlg.

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50—5 to 150 HP, 230 D.C. with and without FA relays.

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8	10	515/1750	78 T	Rel.
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1	20	500/1500	123 SK	Whse.
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2	40	500/1500	SK	Whse.
2	75	500/1500		C W
2	100	500/1500	183 SK	Whse.
1	125	600/1800	1050 T	Rel.
1	250	275/690		G.E.

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Twelve (12)—12.5 KVA 230/400 volts—50 cycle International Harvester—Marble Card.

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Four (4)—250 KW A.C. plus 40 KW D.C. 250/450 V 3 phase, 60 cycle or 200 KW plus 30 KW D.C. 220/380 V—50 cycle Mfg. by General Electric Co.

Two (2)—300 KW D.C. 120/240 volt 6 Pole—3 wire—Comp. Wound Turbine by Worthington Moore. Generator—Allis Chalmers.

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12"x14", 100 P.S.I., Center Drive Flywheel, Lubricator, Unloaders

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Most all units still on foundation. Many may be seen operating

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375 KVA General Electric 2300 v.

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605 HP Union 3 drum 200#
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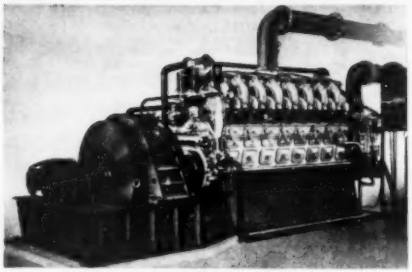

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With tie string at top

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150 HP Babcock and Wilcox number 10 Class H2 Sterling water tube boiler, gas and/or oil fired, with 42" dia. x 125 ft. x 3/16" shell steel stack, also duplex boiler feed pump 6" x 4" x 6", new 1942.

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One 125 H.P. Cyclotherm steam generator built for 125# steam working pressure and arranged for operation with No. 6 oil, gas ignition with 220 volt 60 cycle, 3 phase alternating current.

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50000# B&W 400# Integral Furnace Boiler Pulverizer.
B&W will re-erect & Service.
65000# G-R Evap. Syst.
1500 KW Non-Cond GE Turbo-Gen. 440 V.
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1—100 HP, self-contained, Union Universal Boiler, 150# pressure complete with all fittings. Also one extra all-welded ¼" stack, 42" diam. x 50' length.

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"PROX" header type cast iron sectional Steam boilers (similar H. B. Smith) with grates to burn buckwheat coal complete with all accessories and trim. Also efficient with oil burners, gas burners and automatic stokers. Quantity available 9 #A-60-S-10 rated 6600 square feet net 2 #40-S-8 rated 3410 square feet net. Good condition never used. *Bids invited.*

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480 volts — 60 cycle
160° Pressure

With Condenser and Auxiliaries.
Must be modern machine!
Will consider slightly larger machine.

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USED POWER EQUIPMENT OLD BUT IN FINE CONDITION

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1 "Elliot" reciprocating horizontal steam engine generator #4436. 312 HP. 200 KW. 180 RPM. Cylinder 19"x24". Size K. 115 lbs. steam maximum. 800 Amperes. Installed new 1928.

2 "Brownell" Steam reciprocating horizontal steam generators #5113 & #5114. High (10") and Low (17½") pressure cylinders x 15". 250 RPM. 400 Amperes. 125/250 volts. 100 KW. Installed new 1910.

2 Fairbanks Morse Steam reciprocating feed pumps, 200 lb. steam pressure. Size 7" x 4½" x 10". Installed new 1910.

2 Fairbanks Morse Steam reciprocating oil pumps. Size 4½" x 3" x 4". Installed new in 1910.

1 Jennings Condensate Pump. Capacity 11 gallons per minute. 3450 RPM. DC circulating motor—10 lb. per square inch. Nash Engineering Company of South Norwalk, Connecticut.

Motor Model #55A101. 220 Volts. Semi-closed 1/3 H.P. 1.8 Amperes. Installed new in 1927.

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1 Worthington Vacuum Pump. 6"x8"x12". Steam reciprocating. Bought second hand in 1930.

1 American steam reciprocating vacuum pump. Style AM XM. 8" x 10" x 12". Installed new in 1910.

2 Fairbanks Morse steam reciprocating water pumps. Size 7" x 6" x 10". Installed new in 1910.

Many parts and extras for above pumps. Piping and valves also available in all sizes from ½" to 8".

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BIG MOTORS — NEW AND USED — SUBSTANTIAL DISCOUNTS

Reduction Gears Available for Some of the Above

1—500 HP, 514 r.p.m., 6000 volt, 3 phase, 60 cycle West. C. S., new.

1—450 HP, 514 r.p.m., 440 volt, 3 phase, 60 cycle West. C. W. slip ring, used.

1—400 HP, 720 r.p.m. 80% P.F., 2300 volt, 3 phase, 60 cycle G. E. type TS syn., new

1—400 HP, 720 r.p.m., 80% P.F., 440 volt, 3 phase, 60 cycle G. E. type TS syn., new 250 volt exciter.

1—300 HP, 600 r.p.m., 80% P.F., 440 volt, 3 phase, 60 cycle West. BG syn. with exciter. Pedestal bearing motor, used.

1—300 HP, 600 r.p.m., 440 volt, 3 phase, 60 cycle West. CW slip ring with drum and resistor, used.

1—200 HP, 1200 r.p.m., 80% P.F., 440 volt, 3 phase, 60 cycle G. E. type TS syn. with direct connected exciter and enclosed reduced voltage starter, new.

1—200 HP, 1200 r.p.m., 440 volt, 3 phase, 60 cycle A-C slip ring with drum, resistor and primary switch. New 1948, used 60 days.

1—200 HP, 600 r.p.m., 550 volt, 3 phase, 60 cycle G. E. IM slip ring, used.

1—200 HP, 1800 r.p.m., 550 volt, 3 phase, 60 cycle West., C.S., used less than one year.

1—150 HP, 720 rp.m., 80% P.F., 2300 volt, 3 phase, 60 cycle West. type G syn. with direct exciter and reduced voltage controller. Late, carries new guarantee.

1—150 HP, 600 r.p.m., 440 volt, 3 phase, 60 cycle, GE IM slip ring, used.

1—150 HP, 514 r.p.m., 440 volt, 3 phase, 60 cycle Wagner type BR slip ring with drum and resistor, used.

1—150 HP, 900 r.p.m., 440 volt, 3 phase, 60 cycle A-C., A.N.Y. slip ring, used.

1—125 HP, 720 r.p.m., 80% P.F., 440 volt, 3 phase, 60 cycle GE. type TS syn. with reduced voltage, dynamic braking starter, new.

REDUCTION GEARS

Approx. AGMA class 1 Ratings

2—New Farrel-Birmingham SRH-30, 5 to 1 ratio (30" center) rated 912 HP at 600 input.

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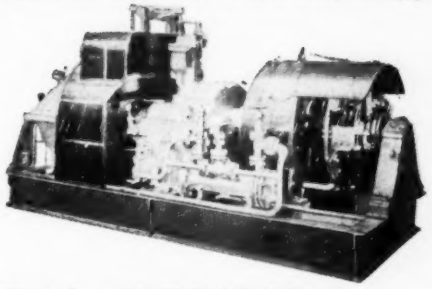

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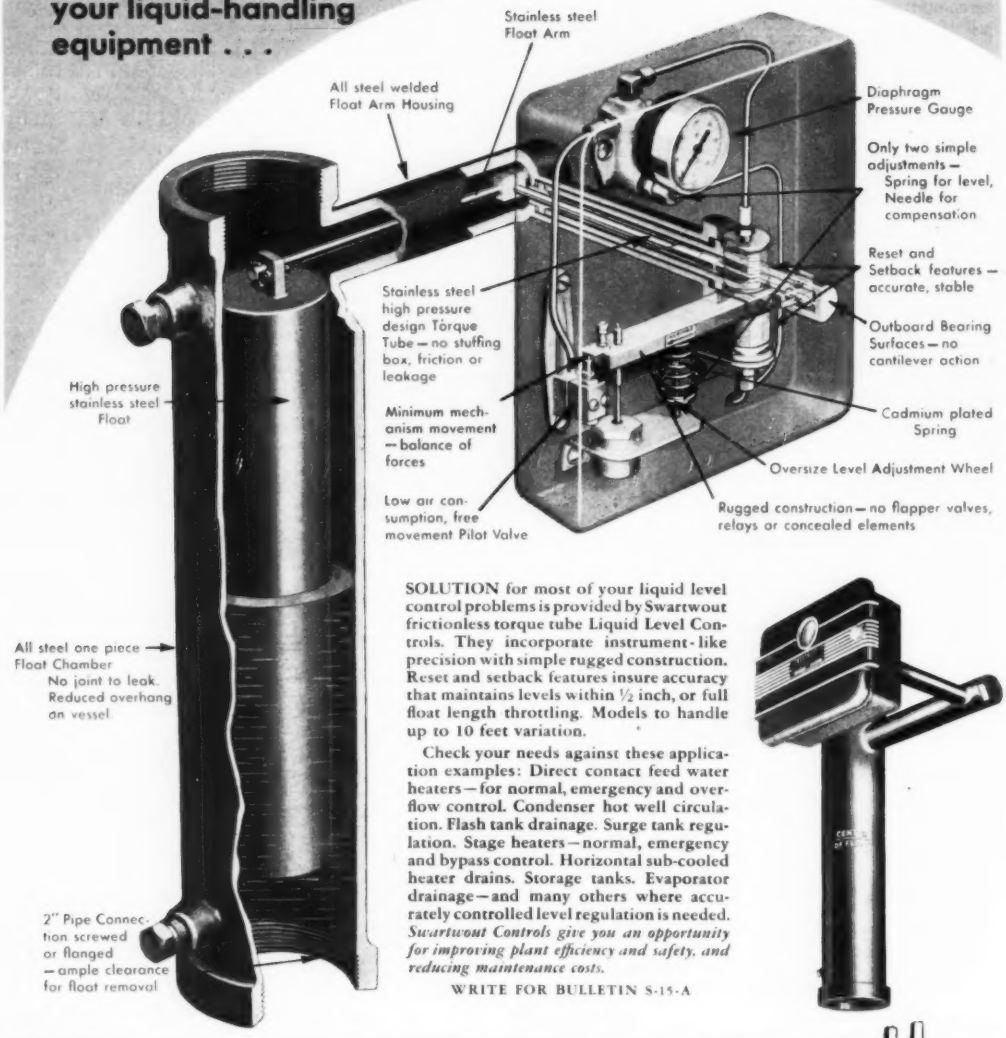
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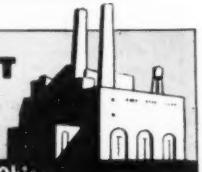

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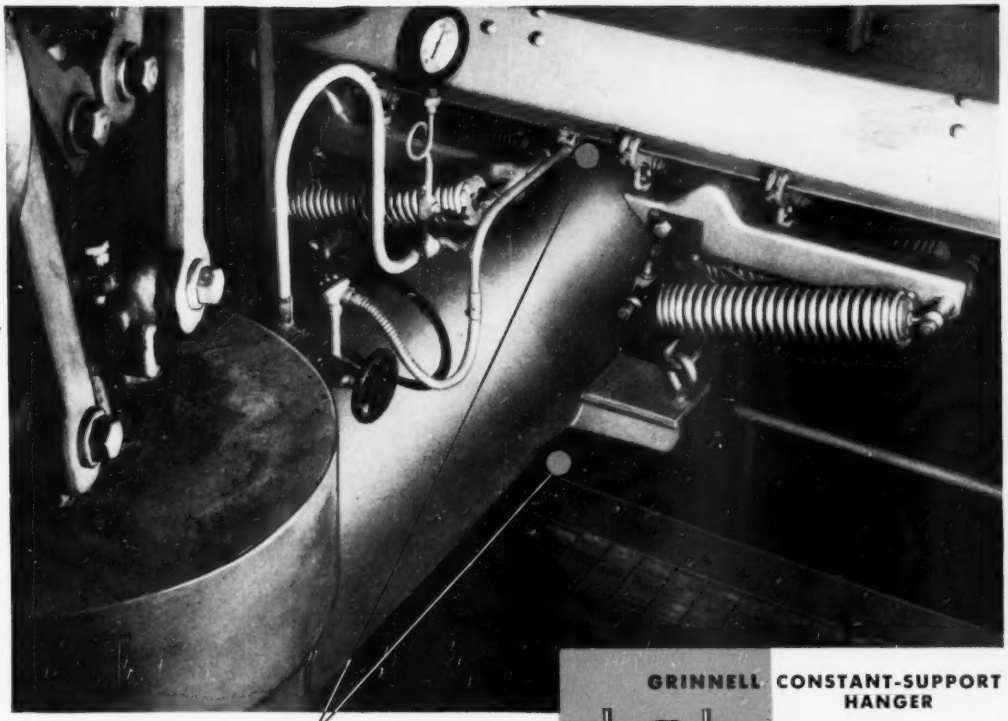

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